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AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 15, NO. 14. WEEKLY. | NEW YORK, THURSDAY, APRIL 7, 1892. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

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A New Automatic Engine.

On this page and on page 2 we give several views and sections of a single valve automatic engine, recently brought out by the J. H. McEwen Mfg. Co., of Ridgway, Pa. The object of the designers has been to avoid parts liable to derangement through attempts at adjustment by unskilled engineers, and to obtain close regulation, economy, and smooth running. The centrifugal action of the connecting rod, etc., is balanced by counterweights in the crank disks. The effect of the inertia of reciprocating parts has received considerable attention, and the compression is so adjusted as to balance the momentum of these parts at the end of stroke. Due consideration has been given to the method of lubrication; shields over the disks prevent the oil from being thrown over the engine room; the oil and drip from different parts of engine are led to inside of frame and are drawn off through a pipe. A flanged trough at the lower outside edge of frame prevents any outside drip from reaching the foundation or floor. The frame has received its share of study so as to obtain rigidity, and enable it to resist, without flexure or vibrations, the stress to which it is subjected.

The main bearing and the crank end of the connecting rod are of similar construction. The caps are adjusted by being drawn up against thin strips of fine calendered paper, and admit of very delicate adjustment. The lining of the bearings is of babbitt metal, carefully scraped and fitted, and can be easily removed if necessary for renewal.

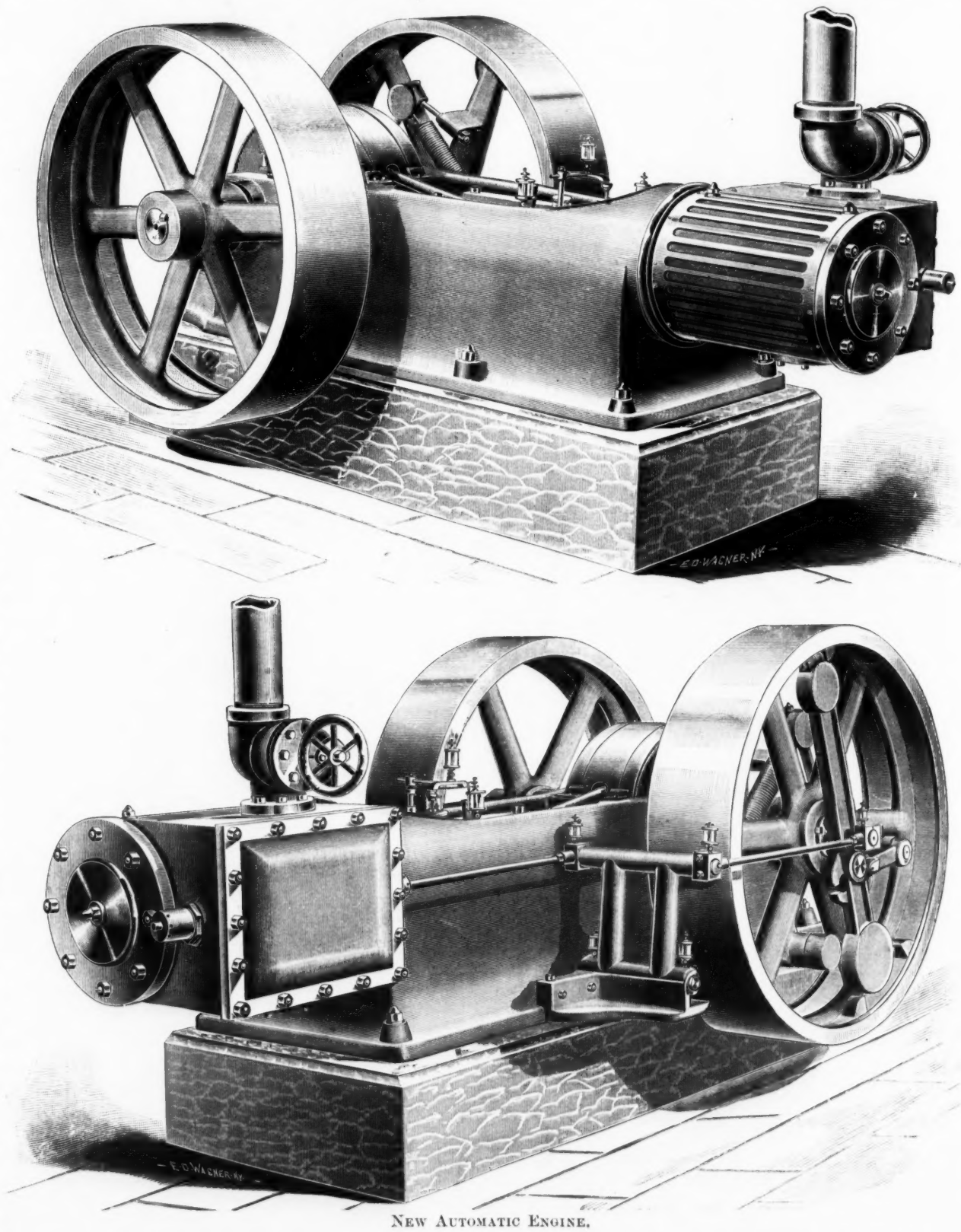
The crankshaft is made of one solid piece of forged steel. The counterbalance disks are of cast-iron fastened to the steel crank by keys. After being keyed, they are turned and polished.

The piston is made hollow and wide, giving plenty of wearing surface. It is packed with cast-iron rings that are made eccentric, somewhat larger than the bore of the cylinder, and are sprung into grooves in the piston, their elasticity keeping them out. The piston head is forced on the rod with hydraulic pressure and riveted; the other end is threaded and screwed into crosshead and fastened with jam nut.

The crosshead is of cast-steel, and has large bearing surfaces, the length being equal to the stroke of the engine in all cases. The pin is of steel accurately fitted and forced in with hydraulic pressure.

The design of the valve motion is such as will change the lead with the load; this tends to equalize the compression, and is an aid to quiet running; for with a constant lead the compression is much greater at an early cut-off than at a late one, and if the compression balances the reciprocating parts with a light load it cannot when the load is heavy.

The construction of the valve and the new design of governor are two notable features of the engine, which greatly contribute to the steadiness of its running under a great variation of load.



NEW AUTOMATIC ENGINE.

The valve shown in Figs. 4 and 5 is provided with a balance plate having port openings of the same dimensions as the ports on the opposite side leading directly to the cylinder, as shown.

The ports in balance plate lead around the valve, both above and below, meeting the passages leading from the ports on opposite side to cylinder, where each passage is increased in area to equal the sum of the areas of the passages up to this point. Care is taken that the port opening on each side shall be of exactly the same dimensions, and directly opposite each other. With this arrangement the valve is perfectly balanced, and the friction which is due to the weight of the valve is very small, and will do no harm. There is no pressure to force the valve against either face, and consequently there can be little wear or leakage.

The valve, valve seat and balance plate are carefully scraped and fitted, and the construction of the balance plate is such that, if the pressure in the cylinder is greater than in the steam chest, the valve and balance plate will leave their seats, permitting the free escape of water without injury to engine.

The governor shown in Fig. 6 is very simple in its construction and action; it appears to be well adapted to keep the engine running at uniform speed under all conditions of load and steam pressure (provided there is pressure enough to do the work); it is sensitive to small variations in load, and its action under greater variation is quick; it is very stable, thereby preventing small periodical fluctuations in speed; it is not so delicate as to be materially affected by friction, wear, or want of lubrication, or by incorrect adjustment of spring, and operates well with fly-wheels of any desired weight or size, or at any speed.

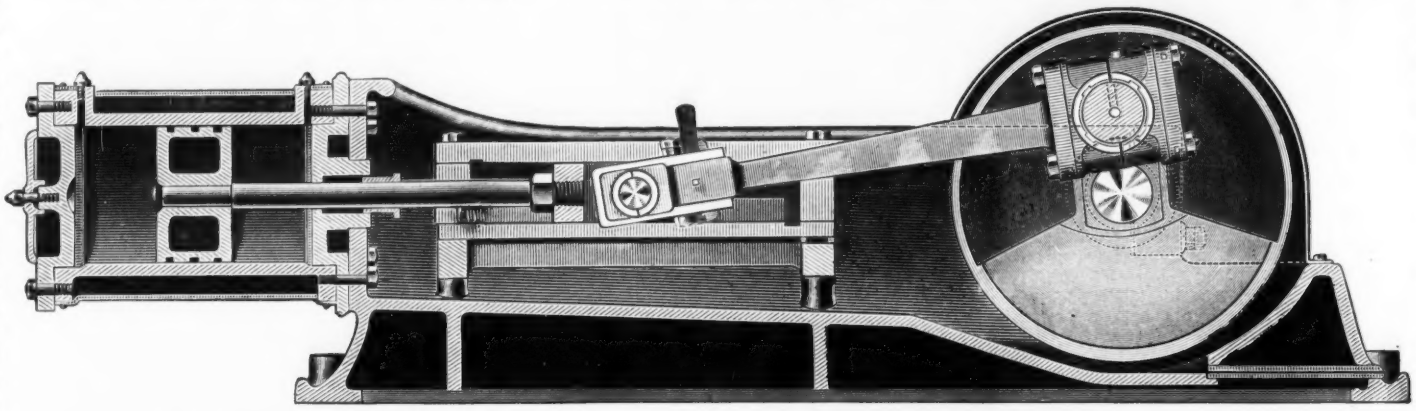
The action of this governor is partly controlled by the centrifugal force of the weight *A*, and by the inertia of the heavy weight *B*. The action of the former weight is, of course, well understood; by a change of load this weight is either moved out from the center, due to an increase of centrifugal force, or drawn toward the center by the spring *S*, when the centrifugal force decreases.

The inertia weight *B* is free to swing on

the pivot *P*, and has rigidly attached to it the pin *G*, from which the motion of the valve is derived; in fact, the pin *G* may be considered to be the eccentric of the engine; when the inertia weight moves slightly on its pivot the relative position of the eccentric to that of the crank is changed, thereby giving greater or less opening to the steam ports. The inertia weight *B* may move in a small arc independently of the motion of the wheels. When a change of load takes place, causing acceleration or retardation of the speed of fly-wheel, the inertia weight will continue at the same speed it had before the change of load took place; but the least change of position of inertia weight with reference to the fly-wheel will also change the relative position of eccentric to that of crank, and consequently will change the amount of port opening so as to admit the required amount of steam to maintain the speed; the inertia weight will come to rest acting against the movement of the fly-weight *A* before it has moved too far in either direction, thereby preventing racing, and restoring equilibrium in the shortest possible time. The dash-pot *E* is simply an air cylinder with a loosely fitted piston connected with the arm *D*. Its position is radial, and the centrifugal action is in line with the cylinder and the piston, and will not produce enough friction to require lubrication. By the addition of this cylinder the stability of the governor is increased to such an extent that its action will not be destroyed by increased friction of any of the moving parts, or by an incorrect adjustment of the spring; it may be taken apart and put together by any workman not familiar with its mechanism without danger of having its action destroyed. The combination of the air cylinder and inertia weight also makes it possible and safe to use a very small and light fly-wheel, if so desired, and to run the engine at any desired speed.

The bearings at the end of the arm *C* are roller pin bearings and require no lubrication. The construction of the governor is such as will not allow the friction of these bearings to destroy its sensitiveness. This will be appreciated by engineers; no oil being used in the governor, none can get on the band-wheel and be thrown over the engine room or on the main driving belt.

Governors may control the speed of an engine very closely in revolutions per minute, but with a sudden change of load the instantaneous change of speed may be quite great. It may affect it only for an instant, but long enough to show quite a change in voltage when the engine is driving dynamos. In work requiring delicate regulation the injury is done during this short period of fluctuation, but with the governor described above the instantaneous change, caused by a sudden change of load, is said to be comparatively nothing. In testing at the works a 16x18 inch engine, running at the rate of 200 revolutions per minute, to see what effect a light fly-wheel would have upon its regulation, there was used a 54-inch fly-wheel weighing 1,200 pounds; with this wheel the engine, it is said, gave perfect regulation; so far as could be discovered by speed indicator or tacometer it did not vary one revolution between no load and 217 horse-power, or from varying steam pressure. At this test it was demonstrated that the governor could be so adjusted that the engine would run faster when loaded than when light, without any tendency to race or change its speed under varying steam pressure.



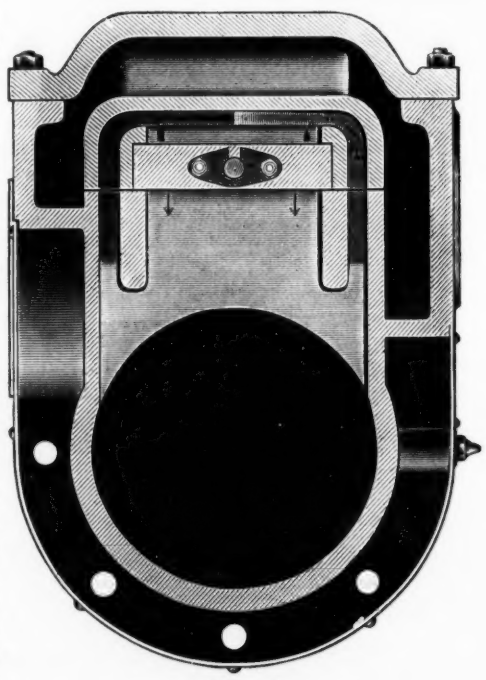


Fig. 4.

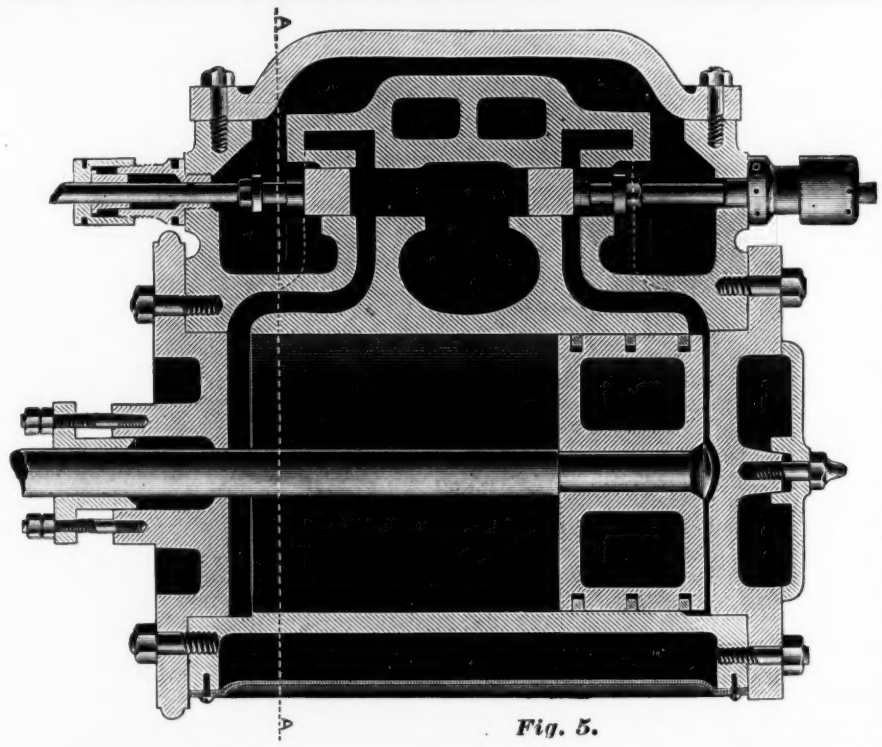


Fig. 5.

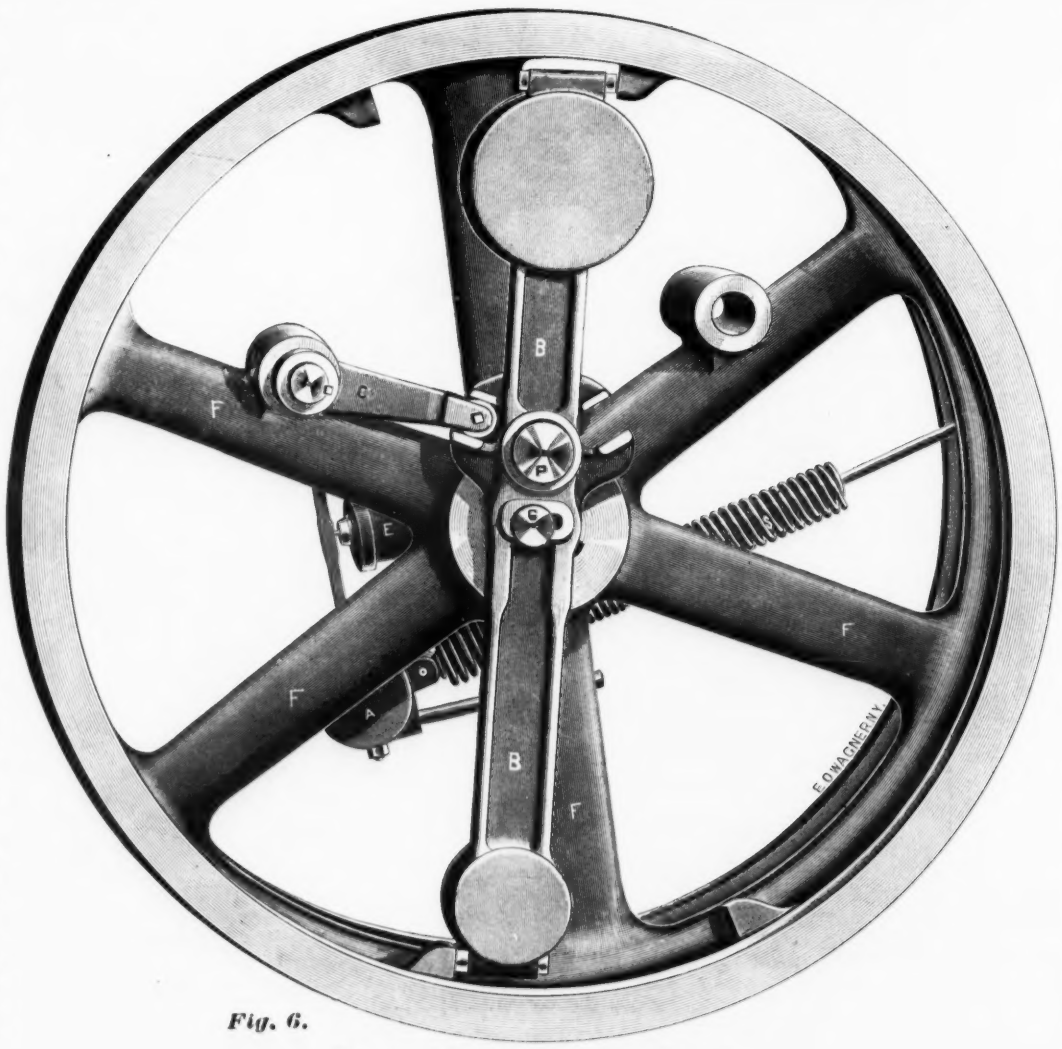


Fig. 6.

New Automatic Engine.—See Page 1.

According to a report recently published in Germany, there were, in 1889, 5,260 workmen killed in accidents, and 35,392 seriously injured. These losses do not vary very much from one year to another. M. Vacher, in *La Nature*, compares the figures with those of the killed and wounded at Gravelotte—one of the most murderous battles in this century—which were 4,449 and 20,977. The industries furnishing most accidents are as follows, in descending order: mines, railways, quarries, subterranean works, building, breweries. All industries are arranged in 64 corporations, and it is estimated that more than 4½ millions of work people are insured. Wounds and fractures are the most usual form of injury, and the duration of treatment tends to increase every year, by virtue of a law which makes an allowance when incapacity for work exceeds three weeks—this was based on the observation that fractures were generally healed in three weeks. Since this law was introduced, the treatment of fractures has taken longer. There are always, *Nature* says, more accidents in winter than in summer, and on Mondays and Saturdays than on other days. Also there are twice as many accidents from 9 A. M. to noon, and from 3 to 6 P. M., than from 6 to 9 P. M. and from noon to 3 P. M. Better light in summer and fatigue towards the end of each half-day of six hours, are supposed to explain some of these variations.—*London Engineer.*

On Thursday, March 3, Lord Low gave judgment in the case of Harpers, Limited, *v.* Barry, Henry & Co., Limited. This was an action to restrain the defendants from issuing a catalogue of power transmission appliances, which was alleged to be an infringement of the copyright of a catalogue of the plaintiffs. The judge found that the plaintiffs had a copyright in all the important parts of their catalogue, and that these parts had been copied by the respondents, either literally or with colorable alterations. He laid it down that the principle underlying such cases was that a person was entitled to reap the benefit of his own skill and labor, and that a publication that is not

merely a collection from sources open to all, but the product of mental labor, entitles the author to a copyright. If other persons thought the scheme of a certain catalogue a good one they might compile a catalogue on the same system, but they must do it for themselves, and were not entitled simply to copy a work which was the product of the knowledge and labor of others. The full text of the judgment was given in the Aberdeen *Evening Express* of March 4.—*London Engineering.*

Ball Bearings.

By W. H. Booth.

At the risk of repeating what I have previously written I would advise A. N. I., if he wishes to use ball bearings, to place them in a series of grooves barely one-half the ball diameter in depth and with the radius of the groove slightly larger than that of the balls.

I think the proper way of making the grooves would be first to turn them exactly to the radius of the balls and then to enlarge them sideways so as to leave the balls in contact over about one-sixth their circumference. Any greater breadth of bearing is not only at a disadvantageous angle, but introduces an excessive grinding action; for, of course, ball bearings are only theoretically correct when the balls roll on a flat surface, or upon a plane cylinder, but in practice they are satisfactory when in grooves of the proper form.

I arranged some time ago, for a bearing for a capstan head arrangement for a special purpose, a double ring of balls, 96 in all, about 44 being in one circle and 52 in the outer circle. Through a mistake of the turner the outer ring of balls never took any load, the groove being made too deep, but the smaller circle did the duty satisfactorily, though only rolling between soft surfaces of malleable cast-iron in place of steel, as intended afterwards to be applied. The balls are $\frac{3}{4}''$ diameter. For smaller bearings I have used $\frac{5}{16}''$ and $\frac{3}{8}''$ spheres, and have applied in this way about 20 balls of $\frac{5}{16}''$ to the repeated stress involved in lifting a load of some 5,000 pounds or more in rock-boring operations.

Necessarily if an insufficient arc of contact be provided at first there will be excessive wear, and a sufficient contact will be crushed out by the balls, and this is undesirable, and therefore it is I advise the grooves to be made to fit the balls and eased off sideways only, rather than of a uniform curvature larger than the spheres. In filling a groove with the balls I put in all that the groove will hold and remove one from each groove, to give freedom.

I would always use balls of as large a size as reasonably practicable.

The small sizes used for bicycles no doubt assist to keep down dimensions, and therefore weights; but for ordinary machinery I think larger diameters are preferable.

An enormous number of steel balls must be now made somewhere. Almost all cycles have them, an ordinary machine having eight rings in all, and tricycles, of course, having more.

One reason for machines being often designed for the discomfort of the attendant is that too often the designers have had too little experience themselves as attendants If work can be done by a man sitting it is a waste of energy to keep him standing, and there must be very many operations where a seat could be provided for a machine, that would add to the turn out of that machine

Where a considerable amount of bodily movement is necessary a seat can still be used if made on the swinging principle, to allow slight movement. Typesetters obtain a free seat by using a center leg stool which readily inclines in any direction, and in some forging operations the hammerman sits in a swing and is able to get through much more work than he could on his feet.

An old-fashioned idea that no one who worked for their living had a right to be comfortable, even if it paid the employer for them to be so, has now fairly died out, except in the thick heads of drygoods men, whose aim in life seems to be to keep their girl assistants standing all day, whether busy or otherwise.

For much work which involves swaying of the body to and fro, the sitting position does not afford altogether free action, as it is more difficult for a man to sway from a fulcrum of a two foot lever upon a rigid seat than from an adjustable fulcrum to a five-foot lever, the adjusting being in the leg and ankle joints, and the angle of sway only two-fifths what it is when seated. The fault lies, however, in the rigid seat, and for such cases I would use simply a double seat, which, in its simplest form, would consist of a pair of flat boards kept

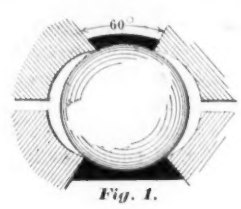


Fig. 1.

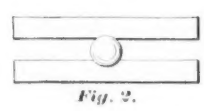


Fig. 2.

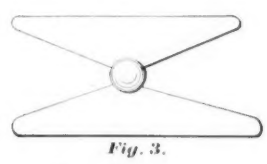


Fig. 3.

Ball Bearings.

apart by a central ball, thus (Fig. 2), from which form Fig. 3 would soon be evolved in order to provide a greater range of motion.

The mechanics of seats generally has been neglected, and except in one position a rigid seat cannot be easy. Oarsmen have found the necessity for a seat which will slide to and fro, and cyclists have required to provide seats with springs to give the equivalent of an all-round swiveling motion, whilst some American chairs are pivoted bodily upon a spring-controlled bearing, and this adds much to their comfort. So far a pine board has seemed good enough for machinists; but this admits of many improvements, and I might add that improvements are likely to be best appreciated by those who do not turn the scale at more than 25 pounds per foot of height.

Hammering Saws.*

By C. E. Grandy.

FOURTH PAPER.

I cannot very well show the process of truing a warped circular saw without a diagram, which is herewith presented and numbered as Fig. 1.

A warp is an uneven surface; in this case it may mean a regular uneven surface; that is, if you should stand the saw on edge, or hang it on a mandrel or a projecting pin, so it will have a chance to take the form that the abnormal strains cause it to tend to, such form will show, when tested by a straight-edge, crowning or convex one way, and hollowing or concave when the straight-edge is applied at right angles to the first position, or it may show a concaved side only half way across the saw, and if you placed the straight-edge at right angles to this it will show convex, this on one side and one-half of the saw, as seen at *a a*, *b b*, Fig. 1. This, as said before, may extend clear across the plate. Now if the place showed convex both ways, it would not be a warp, but a hummock, and would be remedied by forcing down to a true plane with a hammer on a wooden block or cast-iron table that is true; but inasmuch as it is a twist or warp, it must be dealt with in an entirely different way.

It is plain, as seen at *b b*, that you might think a few blows of a hammer would bring the high place where the straight-edges cross down; so perhaps you might, but you would then find the concave, as shown at *a a*, would be much more concaved, and if you turned the saw over you would find it convex, and hammer that down and it would also be concaved again at *a a*. Every trial at this only makes matters worse. It is best first to know what causes this particular shape. It may be from two causes; only one, however, is likely to exist at the same time. If by accident the saw has been actually bent over from a plane, it would be likely to take this form. To illustrate this very plainly, so all can understand it without mistake, note the condition of a saw shown at *a*, Fig. 2, somewhat exaggerated. This bend was caused by a "nip" of a spruce log. So strong was the "nip" that the hook dog was torn out and the log lifted over the top of the saw arbor, and carried back on the frosty head-blocks; the hook dog on the other end of the log forced it out sidewise; this gave a lever about 10 feet long to bend the plate, and it did it, about one inch out of true with that side of the saw from the arbor collar out to the edge.

Now in bending the plate, the edges of the saw at *b*, Fig. 2, curled up, so to speak; that is, while the bending powers exerted more at *c* bent it farther out at *c*, *b* was bent also some, so that if you were to put your straight-edge on the plate at *b* it would be like *b b*, Fig. 1. This condition is often met with in my experience as saw hammerer.

To repair this, first test at *c c*, Fig. 1; it will be noticed that it is concaved; this, of course, is convex at the opposite sides. First, then, place the saw on a large flat wood block, the larger the better, strike blows at *a*, Fig. 2, on the convex side, then turn the plate and strike blows at *c c*, Fig. 1, on the crowning or convex side; continue this until you have effected a change, then extend the blows of the hammer over a larger space, always on the high or crown side; test often with a straight edge. When you have it pretty nearly level, that side of the saw will be somewhat strained, caused by both the bending and hammering.

Place your saw on a steel anvil, and hammer at *d d d d*, Fig. 1, both sides; test often for tension, and see that wherever the drop is that it is all alike; if it drops more at the seat of trouble you will have to hammer it at *d* again, only nearer the center. Here you have got to think and use your brains for all they are worth; in other words, use the best judgment you have at command. Do not be discouraged, but keep trying. If you have over-tension at center, you can counteract it by hammering the edge, and *vice versa*. This warp, as before said, may extend over the whole plate, and is common in saws that are too large on the rim or rim slack. This, as before stated, can be corrected by hammering near the center. But a saw does not take on this shape from over-tension on the edge, unless it is an extreme case; if it will then change on being tipped one way, then the other, it is "loose" on the rim, and is at once recognized; but when you get a saw nearly true and put it on a test mandrel, and find that it will touch the chalk at *a a*, Fig. 3, and on trying the other side it touches at *b b*, it shows that it is yet not true on the edge. The first-mentioned condition is apt to run into this condition; it means that you have got to apply the straight edge at *c c c c*, Fig. 3, and hammer the high places, using a twist pene hammer, with the long way of the pene towards the center, and the same on the reverse side, then finish up with the short straight-edge and dog-head hammer to a true plane.

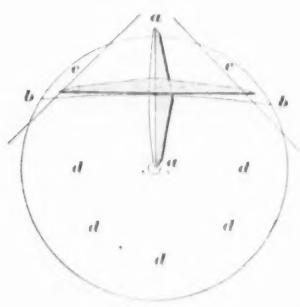


Fig. 1.

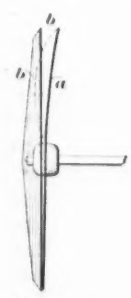


Fig. 2.

Fig. 3.

Hammering Saws.

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A Machinery Man in China.

Mr. Harry Comstock, who is well known in the machinery trade and has traveled over pretty much all the civilized world in the interest of American manufacturers of machinery and arms, has recently returned from Japan and China, where he has been introducing an American machine for hulling rice. As is well known, rice is the chief crop in those countries, and the amount of it that is raised there may be inferred from the fact that there is actually more rice raised in the world than there is wheat, a statement which is somewhat surprising to one who has always lived in a wheat country.

The Chinese have, for nobody knows how many centuries, hulled their rice by a hand system somewhat resembling the pestle and mortar operation, which is not only exceedingly tedious and expensive, but results in a loss of 20 to 23 per cent. from broken grains. By the hand process one "pical" (equal to about 15 bushels) was hulled per day, while the machine hulls 5 picals per hour, at a loss of only 9 to 12 per cent. The machine was developed by Mr. C. E. Lipe, of Syracuse, and both he and Professor Sweet are interested in it.

Mr. Comstock tells many very interesting things regarding his experience in introducing modern machinery in China and Japan, his years of experience in those countries and familiarity with the languages having enabled him to learn many things concerning the customs of the people which can only be learned by actual observation or by conversation with one who has observed them. Their utter disregard of many of the customs and conventionalities which we look upon as of so much importance are apt to be somewhat startling, and yet the spirit of their actions is seen by the unprejudiced observer to be in no way inferior to our own, and, it is evident, has inspired nothing but respect in the mind of Mr. Comstock.

Mr. Comstock corroborates what has been said of the Chinese before, regarding trade unionism. It is developed there to a point not dreamed of elsewhere, extending not only through all branches of labor, skilled and unskilled, but to commercial and professional men as well. A Chinese merchant who fails in business, for instance, is effectually barred from going into business again, not so much by law as by the rules of his guild or union, which make it utterly impossible for him to resume business until everything is made entirely straight. So it is with unions of mechanics and other workmen. The rights of such associations are well settled and universally recognized. It is impossible for any one to follow any pursuit outside of the guild or union, and the union not only protects its members, but also requires them to deal fairly, and to do their full duty in every relation of life.

As a people they are superstitious, and no small part of Mr. C.'s efforts had to be devoted to convincing them that there was no devil concerned in the working of the rice hulling machine, but that it was plain mechanism which could readily be comprehended.

During the recent war between the Chinese and the French, Mr. Comstock was in China, and believed that the Chinese were right. He charges the French with waging a black flag war upon the Chinese, utterly un-

worthy of a civilized nation. The French were having things all their own way, of course, with their superior weapons, and the only time the Chinese were able to defend themselves to any purpose was in an engagement which took place shortly after Mr. Comstock had got into the country some American repeating rifles, and had drilled the soldiers in the use of them, and in military tactics. They surprised the French then, and showed what they could do when the fighting was upon something like even terms.

Horizontal Drilling Machine.

We present herewith perspective and detail views of a drilling machine which possesses some novel features worthy of attention.

The work to be operated upon is supported in front of the machine upon a table provided with T slots as shown, this table being arranged to move along the floor upon planed tracks, the wheels being turned to secure accuracy.

The frame of the machine consists of two columns 6″ diameter, which are placed 18″ center to center, passing through two plates, one at top the other at bottom, to which they are secured. The head is fitted to these columns, counterbalanced and moved vertically to any desired position by means of the rack cut on the front column, into which the pinion meshes. This pinion is turned either directly by the handles *Q* (Fig. 2, page 5), or through the medium of the worm gearing and star handle *T*, this latter being used when setting the drill to a definite point upon the work, where it is necessary to be precise.

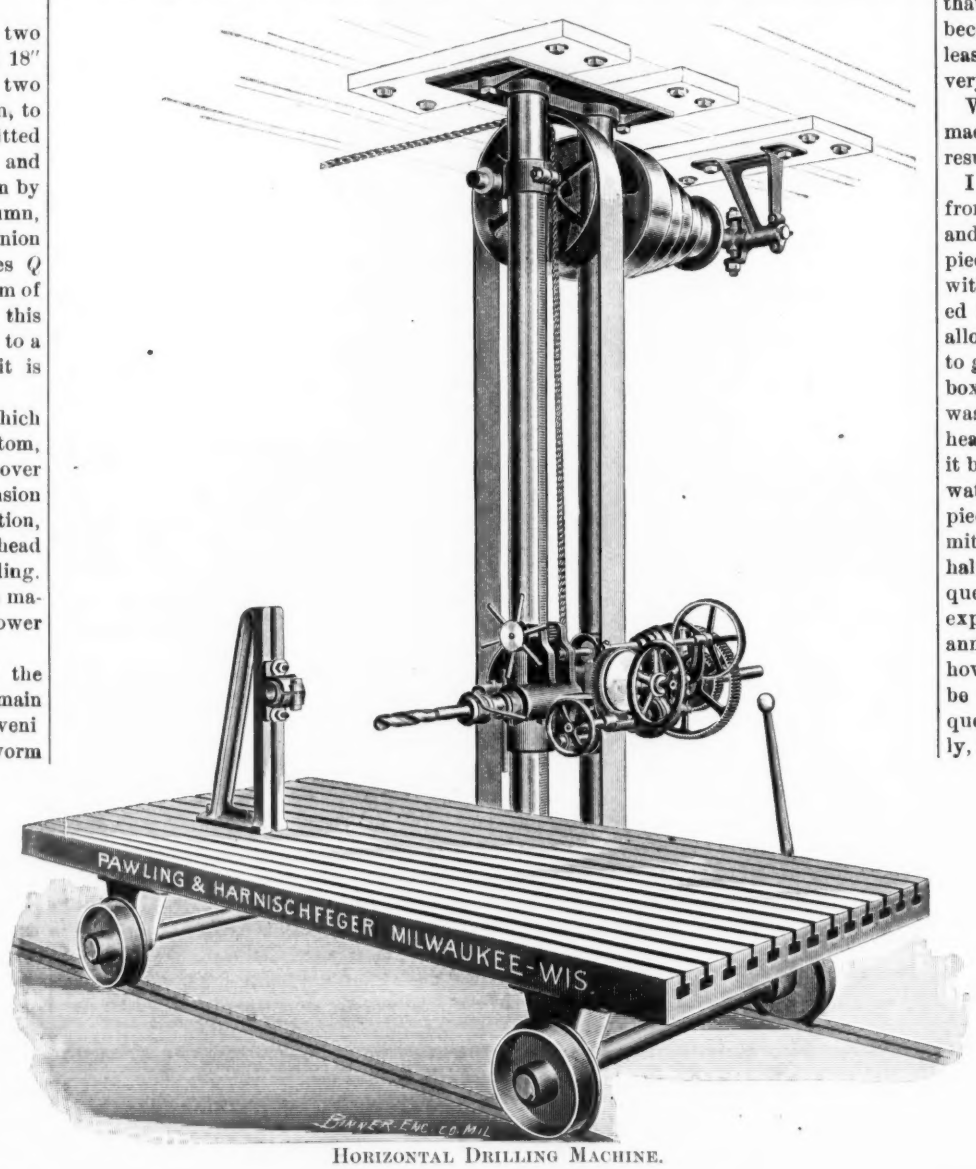
The spindle is driven by a belt which passes over pulleys at the top and bottom, the latter being below the floor and also over idlers in such a way as to make the tension and the driving the same in any position, the belt taking care of itself when the head is moved, whether running or standing. There are two sets of back gears in the machine as made now, giving ample power and range of speeds.

The feed motion is derived from the smaller gears seen at the left of the main driving gear, the belt cones being conveni ently placed, the lower one upon a worm shaft, which is parallel to the main spindle, and having at its extremity a hand-wheel by which the spindle can be fed slowly and powerfully by hand when desired, or it can be fed direct by the handles *O*. Fig. 3 shows the arrangement of these parts as at present constructed, the handles *O* being replaced by a hand-wheel, and the feed so arranged that it is automatically thrown in when the spindle is advanced and the drill comes into contact with the work. This is accomplished by means of a cam ring, a development of which is shown at Fig. 4, this figure showing a portion of the ring as though it were cut in two and straightened out. The lower portion of this figure represents the ring which is fastened to the hand-wheel, while the section-lined parts above represent parts of the ring attached to the clutch. When moving the bar forward, the beveled surfaces of the rings come into contact as shown at the left, the spiral spring shown in Fig. 3 giving sufficient pressure to advance the spindle so long as it meets with no resistance. But when the drill comes into contact with the work, the increased resistance causes the outer ring to advance ahead of the other one, pushing it back into the position seen at the right of Fig. 4, thus throwing in the friction and starting the automatic feed. A reverse motion of the wheel first releases the feed and then withdraws the drill, the motion of throwing the feed out and in being entirely done away with.

Fig. 5 shows the arrangement of the end of the spindle, by which boring bars are secured to the spindle in such a way that they cannot become loose when feeding backwards, as is sometimes necessary, or from any other cause.

It will be noted that the construction of this machine is such that, though comparatively light and simple, it may operate upon work of any desired size, or, in fact, anything which can be got into the shop.

The platen as usually made is 8 feet long, 3 feet 11″ wide. The spindle can be run down a little below the platen, or 7 feet above it. It has a traverse of 20″, with automatic feed at any point. The five-stepped cone pulleys with back gears give ten speeds suitable for drilling or boring holes from ¼″ to 10″ diameter. There is an outboard support for the boring bar which can be used when needed. Spindle is of forged steel, with bearings of ample length and diameter. Idler shafts run in brass boxes. Cut gears are used throughout, the intention being to have the workmanship compare favorably with any other. The builders are Pawling & Harnischfeger, Milwaukee, Wis.



HORIZONTAL DRILLING MACHINE.

In the discussion on a paper by Mr. E. Price Edwards, read before the Society of Arts, on "Burning Oils for Lighthouses and Lightships," Sir Lyon Playfair said mineral oils must in time beat the vegetable oils, on account of their chemical composition, the ingredients in the latter not being all combustible, but consisting of fatty acids and glycerine. Mineral oils, on the other hand, were nearly of the same composition as olefiant gas, the illuminating constituent of coal gas, with the addition of a little more hydrogen. They were therefore sure to win in the end; it was merely a question of manufacturing them safely.

Gov. Flower, of New York, has signed the bill providing for the total prohibition of the manufacture or laundering of collars, cuffs and shirts in prisons of the State. The bill was introduced by Assemblyman Worden, and affects materially Clinton Prison and the Albany County Penitentiary.

During the last three months of last year over 3,000,000 pounds of silver lead ore were sent into this country from the State of Sonora, Mexico.

Annealing Steel.

BY A. D. PENTZ.

My experience indicates that a great deal of misinformation is written and otherwise perpetuated about steel, and especially about the hardening and annealing of it.

A bar of good tool steel being procured, a piece is cut off, and of course it is found to be too hard to be cut cold. In all the years that tool steel has been made, only one company, to my knowledge, has caught the idea that bars of steel for cold operations may best be annealed by the makers, and that company has got there only lately, and on one special brand of their stock. So much of the unannealed bar as is needed is cut off, and it must be annealed for two reasons: first, to soften it so as to make it practicable to be cut; and, second, to neutralize its structural tensions so that, if it be hardened after being shaped, it will be more likely to retain the shape it has been formed to. The piece is needed at once, of course, as it generally is. The smith proposes to "*water neal*" it, and the foreman favors the plan. The tool maker—who is to shape the piece, and who is a very intelligent person—does not like "water nealing." "It does not give me satisfactory results; one part will be soft and another hard; besides, I think, without knowing much about it, that the steel is injured by it, so that the cutter will not keep sharp so long." (*sic.*) The smith thinks differently. "Young man, if I water neal that piece for you, you will be satisfied with it, or ought to be." It is so annealed, and the result is all that can be desired.

Now exactly what annealing is, *as a fact*, will be known at the same time that the facts behind hardening are discovered, and not before. But the processes of annealing are sufficiently well known to make certain every careful attempt to reproduce the operation.

One fact in relation to the hardening and the annealing of tool steel may be stated as being known, and that fact is that it cannot be hardened in any degree at a non-luminous heat; or, in other words, it cannot be hardened by quenching it, if after being heated red it is allowed to cool, so that it cannot be seen by that color in the dark. But, on the other hand, the same piece of steel will gradually part with the whole of its characteristic hardness while being heated from about 400 degrees Fahr. to the luminous temperature. Thus steel presents the anomalous characteristic of becoming soft at a heat much lower than that required to harden it. It certainly is a marvelous fact that steel heated to a very low red, will, by being quenched in water, become immeasurably hard, while the same piece of steel, if cooled a few degrees lower to blackness, and quenched in water precisely like the reddened metal was, will become as soft as it is capable of being when cold. It therefore is necessary that steel should glow with heat before it can be at all hardened by quenching it. Hence, with an understanding of the facts that steel parts with its whole characteristic hardness in annealing before it becomes heated to redness, that it will harden if quenched when at all red, and that it may be quenched at the moment it becomes black without hardening it in the least, the problem of annealing should be a very simple one.

With these well-known facts in mind, I made the following experiments with the results as here stated.

I broke off three pieces four inches long from a bar one inch square of Jessop's steel, and annealed them separately, thus: First piece packed in wood charcoal ashes, and within a plate-iron-covered box slowly heated in a charcoal fire to redness, and then allowed it to remain in the fire, and the fire to go out, removing the steel from the cold box the next morning. The result, of course, was excellent. Second piece packed and heated like the first piece, but watched until it became just black, and then quenched in water; result as good as the first. Third piece heated like the two others, but permitted to cool in the box of ashes about one-half hour after it became black, and then quenched; result like the first two. These experiments satisfied me that to perfectly anneal it, it makes no difference how hot or how cold below redness a piece of steel may be when it is quenched, or whether it be quenched at all, but permitted to cool slowly, the effect is the same.

I then broke off three other pieces like the first ones from the same bar. The first of these I heated to redness carefully, open in a charcoal fire, and holding it so that the slim jaws of the tongs were also heated, then held it in a dark place until it was black, and then quenched it. It was well annealed, but not so well as the first lot was. Second piece was heated the same way in an open fire, but taken out with cold tongs, held in the draught from an open window, and quenched when black. The result was uneven, and just what could reasonably be expected. At the place where it was grasped by the tongs it was about as hard as an ordinary commercial bar of tool steel would be. The third piece was carefully heated to redness, open in a charcoal fire, then it was covered with warm ashes and permitted to cool until some time after it was certainly black, and then it was quenched. The result was quite equal to that obtained in the box-heated pieces.

These second trials assured me that in annealing it is an item of the greatest consequence, after the piece has been heated to redness, that it should be permitted to cool slowly in a warm place, free from draughts of cold air or the contiguity of cold masses of metal or other material.

It seems to me to be a law that in annealing steel it must be heated to redness, but not necessarily higher. It must then be cooled to blackness very slowly and carefully, and after it is entirely black it may be quenched at any time or by any means.

The conditions under which a tool maker works may vary considerably in different shops. This week he may be one of fifty favored creatures in a fine room with varnished benches—I once worked where

the bench was cherry, and French-polished—where there are laborers to clean the tools and benches, where there are special smiths to suit each variety of work, and where everything is clean and convenient. But the pay in such shops is not likely to be great. Next week the same tool maker will work alone in a corner of a dirty factory with one lathe, a crank planer, a forge, and an index milling machine for his companions. But here he will have a dollar more per day, and more respect shown him individually. In a place of this kind a tool maker finds out something about the way steel works when it is hot. The manager of one shop actually gave me as a first job two bars of ⅝ octagon steel to be forged into center punches, and I did it. Furthermore, it was summer time. In doing this job I found that if the steel was hammered just at the point when it was turning from redness to blackness, that it was liable to split, and if it were marked and broken at that heat that it was "short," and broke like a piece of putty. When red it was tough and tenacious; when black it was strong and hard, but for one moment, when it seemed to be either or neither, it was rotten.

Re-annealing has one advantage, and it has at least one disadvantage. After a milling cutter is roughed out—the hole being bored, of course—a re-annealing is of service in preventing to a great degree the contorted shapes to which shrinkage in hardening at times twists such things. It is believed that structural tensions and unequal strains are removed more perfectly by annealing the hollow cylinder than was done by the first annealing of the solid one. Of course, if it be possible to bore the steel unannealed, as it comes in the bar, the subsequent annealing will be all that is required; but this frequently is not a practicable thing to do. The disadvantage of re-annealing is that, every time steel is heated without hammering it, it certainly deteriorates in quality. This is well shown in re-cut files when the conditions are of the best to get good results.

What I have said about milling cutters furnishes an excuse for me to say a few words further on their manufacture. The present practice is to cut from round bars of tool steel having the right diameters, suitable lengths for the cutters needed, and from these blanks to make the cutters. This makes an ideal facing mill, or one that is to cut entirely on the end or side, because the steel from a bar will be found to stand more strain lengthwise than crosswise, and to keep a sharp edge longer, if such edge be made on the end of a bar than if it be made on the side. Hence cylindrical milling cutters that are made from round bars, as stated, will neither have as much strength nor as much endurance as if they were made from steel specially forged for them. Cracks in hardened pieces, where they cannot directly be traced to improper forging, heating or quenching, will invariably be in the lateral direction. The cause for this probably is that the structural elements of the ingot, whether these elements be atoms or larger crystals, are drawn lengthwise with the formation of the bar, and have in some degree a fibrous or elongated arrangement and shape, and lie parallel to each other, presenting ends to edges cut on the ends of the bar and sides to edges formed on the sides. It is obvious that an elongated particle which thus is a part of solid steel will be more easily displaced by force against its sides than by the same force applied to its ends.

Now steel for a milling cutter to have its "grain" or its elongated crystals lying radially is not a cheerful problem for a steel maker, a smith or a machinist to contemplate. Of course, if a cutter be thin, like a straddle mill, it may be cut from a flat bar, and thus have its grain radial at two points, but that gives but little practical assistance where long cylindrical cutters are needed.

The "*jumping*" process in forging of reducing length and enlarging the size by blows on the ends tends to radiate the grain, but also to loosen the structure at the surface, and therefore would be of little service in practice. I would suggest that the teeth be forged or swaged into milling cutters, either hot or cold. The whole of the outfit is already invented and in use for many kinds of manufactures. All that is required to be done is to provide a spiral feed and suitable guides for the blank, and to have a radial swaging blade for each tooth to operate simultaneously on the blank. While this may not produce the ideal radial grain, its tendency will be to do so, as well as to condense the fiber of the metal, and I believe if this be found practical that standard cutters could be made thus very cheaply and good.

Apropos to the inquiry on the first page of your issue of March 3d inst., about the action of cyanide potassium on hot steel, I have further to say that, in some experiments with that chemical as a welding flux, we observed that the surface of steel at a high welding heat would, under its protection, flow and fall in drops, but that there were but few scintillations of burning metal, perhaps none where the surface was kept covered with the cyanide.

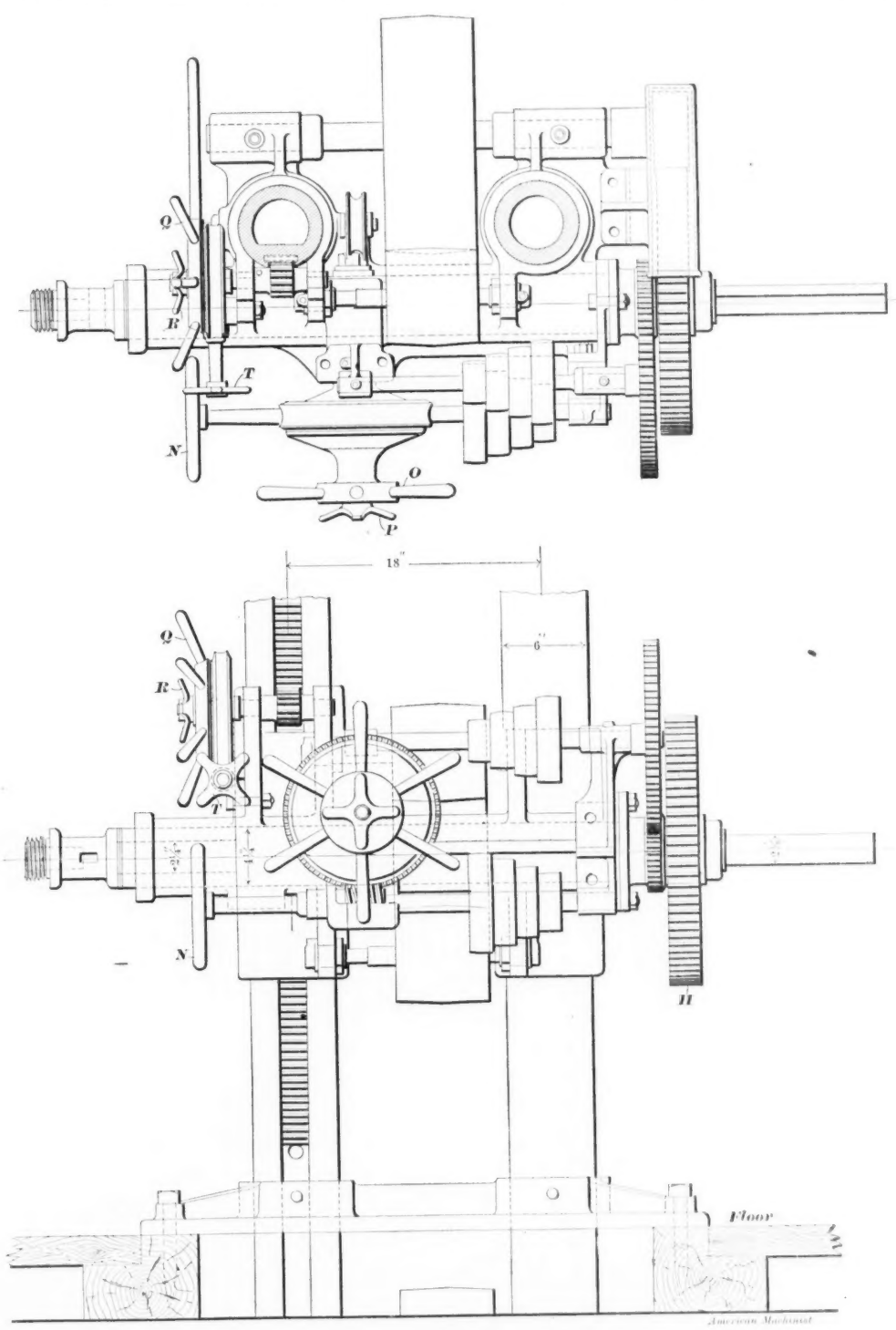


Fig. 2.

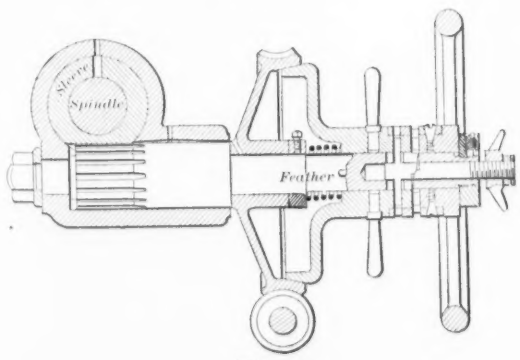


Fig. 3.

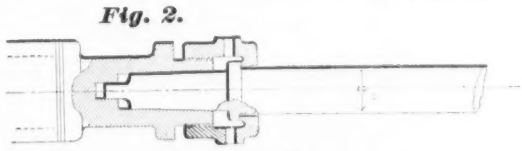


Fig. 5.

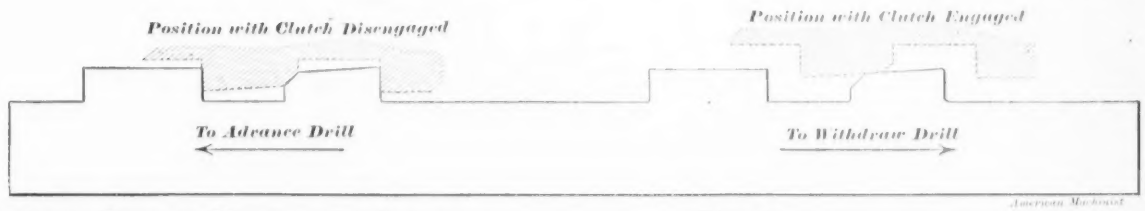


Fig. 4.

HORIZONTAL DRILLING MACHINE.—SEE PAGE 4.

Designing New Machinery.

BY HENRY B. MORRIS.

IV.

In originating machinery of the class which is intended for the manufacture of something, especially of small articles, the designer is often met, at the outset, by the very important question of how much the machine shall do; how many different operations it can profitably perform upon the material. It is highly necessary to settle this matter correctly; yet the problem involved is sometimes a very intricate one. Persons who have only a superficial knowledge of such affairs are apt to suppose that because many articles, like envelopes, wood-screws, etc., are finished from the rough stock by a single machine, this is the result to be generally aimed at and expected. As a rule, the contrary is true, at least in the beginning, while any of the cardinal features of the process are yet in the experimental stage. Of course no general law can be laid down that will govern all cases; but it is safe to say that, where the machine is materially complicated by being made "automatic," this should not be attempted. Sometimes it is desired to perform several successive operations, each of which could be well and rapidly done upon an independent machine, which would be a simple and reliable affair; but the mechanism needed to connect these machines together, and to feed the work from one to the other, complicates matters beyond all reason. These parts of the machine are as likely to become deranged as any of the others, thereby adding a very large factor to the chances of commercial failure; for if one part of the mechanism is disabled all business must be suspended until repairs can be made. The beautiful automatic machines which we have all seen, whose complex operations are all harmonious, and whose work so perfect, are generally the result of long years of experience in running, independently, their separate parts. Until the designer is sure of his familiarity with the cardinal difficulties of his new enterprise, great caution should be observed in marshaling difficulties together, which, singly, might readily be vanquished.

In estimating the degree of intricacy or delicacy of construction that is admissible in any given case, much depends upon whether the machine is to be operated privately, in a factory, where none but experts will be allowed to touch it, or whether it is to be sold broadcast throughout the country, to be handled and abused by clumsy ignorance, with no notion of care, oil, or cleanliness. In the latter case, it hardly need be said that the new device cannot be too simple, coarse and strong.

In contriving your machine, avoid, wherever possible, the use of cams for imparting motion to the working parts. In many cases, of course, the irregular movements which can be derived from cams are indispensable. But a crank or eccentric, where it can be used, is much to be preferred, on

account of its comparatively trifling wear, and the absence of jar. When cams must be employed, let it be to actuate light moving parts, and not heavy bodies, unless the movement is very slow.

Avoid, also, as far as possible, long or rapid reciprocating motions. They are always troublesome, and unless the parts so moved are very light, are usually destructive to the machine. Let all the working parts be positively driven. As a rule, do not depend upon gravity, and still less upon springs, even for return motions, of any parts whose failure to act might disarrange the rest.

Let no part of your machine be insufficient or inadequate to its duty. If you are in doubt upon a question of dimensions, or choice of material, decide the matter summarily in favor of what you believe to be the safest plan.

Make no attempt to use parts of an old machine, merely because you or your employers happen to have them on hand. I have often seen this done, and it generally became a cause of regret all around. You can look the old machine over if you want to, but there is probably no part of it, except the driving pulley, that you can use without a serious change in your plans, or more expense than for new stock. And do not be induced by any fancied saving of time to substitute inferior material on account of difficulty or delay in getting what you know is the right thing. You are entitled to every fair chance of success, and ought not to be handicapped by needless difficulties of this sort, which common prudence can foresee and should avoid.

Special Micrometer Caliper.

The illustration accompanying this is of a micrometer caliper, which was first devised for the use of boiler inspectors who wish to measure the thickness of boiler sheets. The hook, the end of which is opposite the end of the measuring screw, is to be introduced through a hole drilled in the sheet for that purpose, a $\frac{1}{4}$" gas tap hole being large enough. Before introducing it, the knurled collar is loosened, and the knurled-head screw run back about two revolutions. This allows the shank of the hook to be moved endwise, and turned to the position shown by the dotted lines. After being passed

SPECIAL MICROMETER CALIPER.

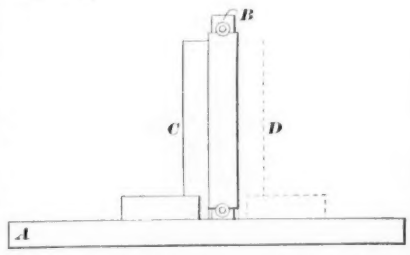
through it is restored to its normal position, and the micrometer screw is then run down onto the plate, and clamped in position by the small screw seen at the right. The hook is then again released and taken out, when the reading of the micrometer gives the thickness of the sheet. This enables the caliper to be read in any convenient place, instead of having to read while in position, which, as the measuring is frequently done in dark places, or where it would be very inconvenient if not impossible to read the caliper will be appreciated. It has been found to be useful also in measuring in otherwise inaccessible places. It is made by Riehle Bros. Testing Machine Co., Philadelphia, Pa.

LETTERS FROM PRACTICAL MEN.

The Test of a Square.

Editor American Machinist:

The company by whom I am employed ordered a 24-inch square from a prominent tool firm some time ago, to be used as a test square, and I was detailed to examine it. As it was not accepted, because we claim it was not square, and as there was some dispute as to the accuracy of the method used in testing it, I send you a description of the same for your opinion, and wish you would invite criticism from your readers.



The general plan was to see if the sides of blade and stock were straight edges and parallel with opposite sides, and at right angles with one another.

As the square was acceptable as to straightness and parallelism, I will not enter into that. The dispute is about the method used in testing for squareness.

We happened to have on hand at the time a large cast-iron plate, and two new B. & S. straight edges, 27" and 39" long each. These straight-edges were tested as straight edges with each other, using tissue paper (which we had found by micrometer to be just .001" thick) as feeling pieces, in many different positions, end for end, side for side, and found correct. They were next tested for parallelism and found correct.

We next tested the plate *A*, which had just been planed, with the 39" straight edge, and tissue paper placed every three or four inches apart, being careful to keep the straight edge at right angles to the plate, and found it eorrect.

Next we successively moved the straight-edge along, reversed it end for end, side for side, and again end for end, and found it to hold tissue paper in all positions.

We now fastened a wooden bracket *B* to the plate *A*, care being taken not to spring it, and for which we immediately tested. The 27" straight-edge was next secured to the bracket by the small clamps with cardboard underneath as shown, and fastened just enough to hold. The square was now placed in position *C*, and the straight-edge adjusted until tissue paper would pull the same top and bottom. The square was next placed in position *D*, and if it had been correct the paper should have felt the same. It did not, and stood off at the top, so we noted the number of pieces of paper required ro make it feel at the top as it did at the bottom. Next the 27" straight-edge was reversed, end for end, and gave exactly the same result, or another proof that it was parallel. We felt safe in saying the square was not true, and that the apparent error shown was twice the real error.

The manufacturer states that they have very little confidence in our method; that they test their squares by two master squares, and these by each other, and that in testing squares careful attention should be given that the square and test piece are at the same temperature.

I cannot see any fault with our method as a method, and we certainly tried to use it as skillfully as possible. It appears to me that a plane surface and a straight-edge with parallel sides would be easier to originate and keep in repair than two master squares, and as for temperature it applies alike to both methods.

If their lack of confidence is in the person testing, they do not so state; and if it is against the method, as they do state, I fail to understand it.

I am quite willing to learn, but the mere condemnation of any method without explanation, by an authority however reputable, is not very logical or very convincing.

F. F.

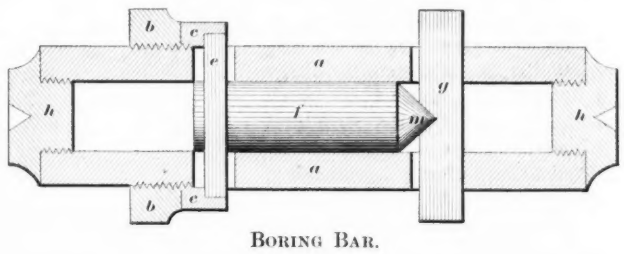
Caliper—Boring Bar.

Editor American Machinist:

In your valuable paper of February 4th, the article, "A Remarkable Surface Gauge," brings to mind a caliper I had about thirty-five years ago, and of which I send you a sketch.

The caliper was made by an old gentleman who was employed as a mechanic in the school where I received my little education, to keep the models and machinery in order. He was a most expert workman in fine work and models, and I do not think I will do any harm to any one if I say I have not met another one yet that could do better work with such tools as he had.

There were about 300 scholars in that school, and I think I was the only one he allowed to come into his workshop. Of course I did all I could to show him how much I was obliged to him, and by-and-by he let me do some brass turning. But now my trouble commenced, as it was most too much for me to make a fit with the caliper; and he would not let me take a file, as he said to me: "If I cannot teach you to make a fit without a file you will be no machinist in your life." Of course I made many mistakes, but the old gentleman never ran out of patience, and told me to go on. By that time I studied to find some way by which I could see when I had the caliper too tight or too loose, and out of this I got the idea of this caliper. As soon as the old gentleman understood my idea he made two pairs of calipers with the utmost care and skill, and after I had them I could make any required fit.

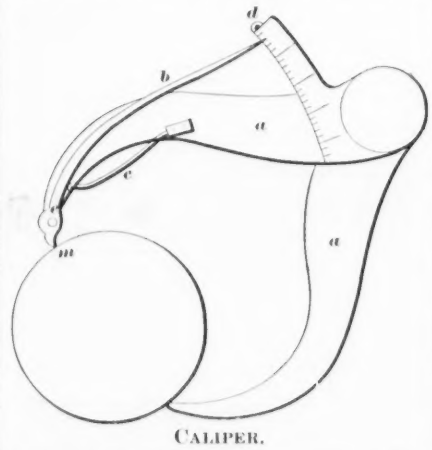


BORING BAR.

As the sketch will explain the idea fully, I will not write a description; but I think if any one of our fine tool makers would make these calipers they would sell very well.

I also send you a sketch of a boring bar which I have used with good success, and which seems to have some good points. I show one form, though of course it is obvious that it can be made in several others, and of any desired length.

The body of the tool is made of a heavy steel tube *a a*, which is threaded externally for the nut *b*, this nut bearing on the loose ring *c*, to which is fitted the piece *e*. This piece *e* passes through the pointed piece *f*, the end of which is hardened, and bears in a countersunk place in the upper edge of the cutter *g*, centering it accurately every time it is put into the bar. Such a bar can be



CALIPER.

used either in the lathe on centers, as indicated, or can be adapted to use in the drill press or boring machine by being fitted with a suitable shank.

J. R.

Milling Cutters—Punches—Change Gears.

Editor American Machinist:

Acting upon a suggestion from one of my tool makers, I recently had some milling cutters made of cast-iron with mushet steel teeth cast in. To my surprise the casting came out of the sand with the steel completely annealed; several attempts were made to harden the now soft steel teeth by heating the entire cutter and cooling in a draught of cold air; but without success. They were finally hardened by heating and dipping in cold water, as with ordinary tool steel. Not a tooth cracked; the bar from which the steel teeth was cut was hard as usual with this class of steel, and could not be filed. Will some steel expert tell me what happened to the mushet steel in this case? Applying it to the emery wheel, it gave forth the same dull red spark after it was annealed as before, showing the retention of tungsten.

I am now using milling cutters as large as 12½" diameter, with ordinary tool steel teeth cast in, and find that they can be made at less than half the cost compared with solid steel or inserted tooth cutters: The teeth can be set as closely as $\frac{1}{8}$" apart, and at any angle required.

Some time ago, while prowling about the machine shops of Toledo, O., on an idle day, I ran across a new wrinkle, to me at least. In a small shop on one of the back streets were a lot of small wheel tires of galvanized wrought-iron $\frac{3}{8}$" thick, with a number of $\frac{1}{8}$" holes punched in them for spokes; upon inquiry it was shown that it was done by using bits of Stub's steel wire held in a small chuck in the punch plunger. These bits were simply cut off, hardened and ground off on the end. The proprietor told me that they had been unable to turn up a punch in a lathe, in the usual way, that would begin to do the work.

The matter of change gears for screw cutting lathes seems to have had but little attention from tool builders. There is practically no uniformity of practice among them, and most of them seem to have been calculated by the *rule of thumb*.

My attention was recently called to the matter while working up tables like those given below, for shop use.

No. 1.

SPINDLE.

SCREW	24	48	60	64	72	78	80	84	88		
24		1	¼	⅜	⅜	1/13	⅜	½	6/11	1	7 whole number threads.
48	4	2	1½	1 1/16	1½	1 2/13	1½	1¾	1 7/11	2	
60	5	2½	...	1 7/16	1½	1 7/13	1½	1⅞	1 5/11	3	
64	5½	2¾	2⅛	.	1½	1 11/13	1⅝	1 15/16	1 3/11	4	
72	6	3	2½	2¼	...	1 1/13	1½	1⅞	1 7/11	5	
78	6½	3¼	2⅔	2 7/16	2¼	...	1 1/10	1⅞	1 11/11	6	
80	6⅔	3⅓	2⅔	2 5/8	2⅔	2 8/13	...	1 15/16	1 5/11	7	
84	7	3½	2 1/12	2 7/16	2⅓	2 5/13	2 1/10	...	1 1/11		
88	7⅓	3⅔	2 1/12	2 5/8	2⅔	2 10/13	2⅔	2 5/11	...		

No 2.

SPINDLE.

SCREW	24	32	36	42	48	54	60	64	66		
24		3	2 1/4	2 2/7	2	1 5/7	1 2/3	1 1/7	1 1/11	2	10
32	5⅓	4	3	2 4/7	2 2/3	2 2/7	2 1/3	2	1 10/11	3	11
36	6	4½	.	3 3/7	3	2 6/7	2 1/2	2 2/7	2 2/11	4	
42	7	5¼	4⅓	.	3½	3 1/7	2 11/12	2 2/7	2 2/11	5	
48	8	6	5 1/4	4 4/7	.	3 5/7	3 1/3	3	2 10/11	6	
54	9	6¾	6	5 1/14	4½	...	3 2/3	3 3/7	3 3/11	7	
60	10	7½	6⅔	5 5/7	5	4 2/7	...	3 3/7	3 3/11	8	
64	10⅔	8	7 1/12	6 2/7	5⅓	4 12/21	4 4/9	...	3 10/11	9	
66	11	8¼	7½	6 9/14	5½	4 5/7	4 2/3	4 1/7	...		

No. 3.

SPINDLE.

SCREW	30	40	50	60	70	80	90	100	110		
30		4½	3 3/7	3	2 9/14	2 1/4	2	1 4/7	1 7/11	2	11
40	8	.	4 2/7	4	3 3/7	3	2 6/7	2 2/7	2 2/11	3	12
50	10	7½	...	5	4 4/7	3 3/4	3 1/3	3	2 8/11	4	14
60	12	9	7½	6	5 1/7	4 1/2	4	3 2/7	3 3/11	5	15
70	14	10½	8 2/7	7	...	5 1/4	4 2/3	4 1/7	3 8/11	6	16
80	16	12	9 2/7	8	6 6/7	.	5 1/3	4 2/7	4 4/11	7	18
90	18	13½	10 2/7	9	7 5/7	6 2/3	...	5 1/7	4 10/11	8	20
100	20	15	12	10	8 4/7	7 1/2	6 2/3	...	5 5/11	9	22
110	22	16½	13 1/7	11	9 3/7	8 1/4	7 1/3	6 2/7	...	10	

17 whole threads.

No. 4.

SPINDLE.

SCREW	20	30	40	50	60	70	110	120	130				
20		8	6	4 2/7	4	3 3/7	2 2/11	2	1 1/13	2	11	22	44
30	18	...	9	7 1/7	6	5 1/7	3 5/11	3	2 2/13	3	12	24	48
40	24	16	12	9 2/7	8	6 6/7	4 4/11	4	3 3/13	4	13	26	52
50	30	20	15	...	10	8 4/7	5 5/11	5	4 4/13	5	14	28	66
60	36	24	18	14 2/7	...	10 2/7	6 6/11	6	5 5/13	6	15	30	72
70	42	28	21	16 4/7	14	...	7 7/11	7	6 6/13	7	16	33	78
110	66	44	33	26 2/7	22	18 6/7	...	11	10 3/13	8	18	36	
120	72	48	36	28 4/7	24	20 4/7	13 1/11	..	11 1/13	9	20	39	
130	78	52	39	31 1/7	26	22 2/7	14 3/11	13	...	10	21	42	

33 whole threads.

It was found that the 10 change gears of a well-known make of lathe would permit of

cutting only seven whole threads; while of two others equally well known, one would cut ten and the other seventeen whole threads. Here were three lathes of the same swing and capacity between centers, and presumably of the same cost, one of them having more than twice the screw cutting capacity of another.

Take the first case as shown in Table No. 1. What a host of fractional threads!

With the single exception of the standard pipe thread (11½), no one wishes to cut a fractional thread in ordinary shop practice, unless he happens to be an Englishman, and is thoroughly convinced that a fractional thread will necessarily have to be brought back to his shop for repairs, since no one on earth would be able to cut it but him.

Table No. 3 is the best I have seen in actual practice, and is from a lathe built near your city. This lathe has more gears than shown in the table, and will cut a greater number of threads. I have taken the first ten gears only for comparison with Table No. 1, its lathe being fitted with only ten gears.

I wish to show that ten gears are sufficient to cut all the usual threads, with the exception of perhaps 11½; in ordinary practice any fractional thread between 11 and 12 will be near enough for the customary short pipe thread; if not, the addition of a single gear will give it.

Table No. 4 is from an imaginary lathe, in a visionary machine shop, and gives nearly five times as many threads as Table No. 1, making the lathe, from a screw cutting point of view, more than four times as valuable.

It will be noticed that, in this table, the pitch of the lead screw is 12, and it may be objected to as too fine for the purpose.

It is intended to rectify this by making the real pitch 6 or any other desirable pitch and establishing the proper ratio between the lathe spindle and the gear stud.

W. R. MACDONALD.

Feed-water Purifier.

Editor American Machinist:

In your answer to S. A. M., Question 69, current volume, you offered a wise suggestion, viz., the use of feed-water purifier.

It should be understood that the term feed-water purifier does not imply the use of an ordinary exhaust steam heater and purifier, so called.

There is not sufficient heat in the exhaust steam from an engine to deposit the matter carried in solution by the water. In order to deposit the scale-forming matter in water in a feed-water purifier, the water must be passed through and brought in contact with heat equal to that under which it is deposited in a boiler.

To do this the feed-water purifier must be connected with the boiler from the top of each by a pipe suitable in size to maintain the same pressure in the purifier as is carried in the boiler; the water also pumped into the top of the purifier, which is placed above the boiler, and connected by pipe from the bottom to the boiler somewhere below the water line. This lower connection must have a check valve near the boiler. This is the best system to quickly and effectually clean and purify the water to be used in a steam boiler, and it is only a question of a few dollars that keeps this system from being more extensively used than it now is.

Should Mr. S. A. M., like many others, think it extravagant to purchase a live steam feed-water purifier, which is much cheaper and a great deal more practical than a surface condenser for a small plant, I would suggest that he build a cistern sufficient in capacity when full to supply the boiler from one cleaning until the next. Fill the cistern from the shop roof, and the waste water from the engine, and run alternately between cleanings of the boiler from the cistern and well, as one kind of water will counteract the other. If after a time he finds the well water is too strong for the cistern water, an occasional use of a good boiler compound will assist in keeping the boiler comparatively clean, with careful watching and frequent cleanings.

Notice.—Water should never be allowed to stand in a steam boiler until it becomes entirely cold, as dangerous corrosion is occasioned in so doing.

Neither should the water be let out of a boiler while there is any steam in it, as the scale formed is made harder and more tenacious by such a practice.

When the boiler is emptied it should be immediately cleaned out, and not allowed to dry in a dirty condition.

S. A. SMITH.

Thickness of Cylinders.

Editor American Machinist:

You are entirely correct in your answer to A. F. M., regarding the strength of cylinders, "that the whole matter reduces itself to this question, What factor of safety shall we adopt?"

For hydraulic cylinders a smaller factor of safety may be employed than would be wise to use in the case of a cylinder, to contain a material of great expansibility on being relieved of resistance, like the effect of the rupturing of the cylinder.

It appears to me that A. F. M. has stated his formula wrong; that it should be stated as Rankine states it in his "Applied Mechanics."

$$\frac{R}{r} = \sqrt{\left(\frac{f + q^{\circ}}{f - q^{\circ} + q_1}\right)},$$

where R equals external radius,

r equals internal radius.

f equals coefficient of strength.

q° equals internal pressure.

q^{1} equals external pressure.

That is, the value of the ratio of the external to the internal radius required in order that q° may be equal to f, the bursting or working tension, as the case may be.

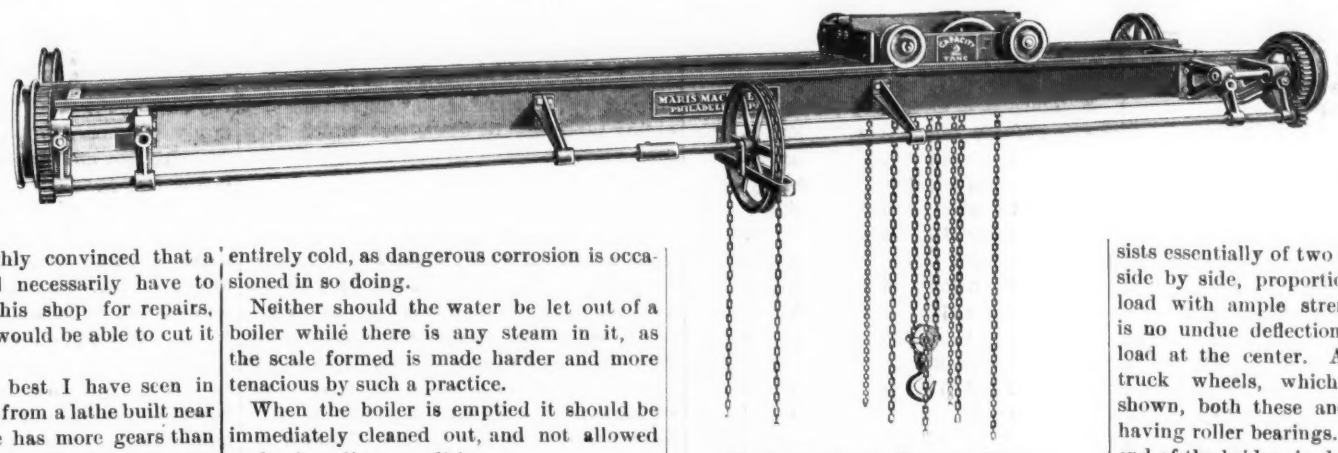
In the most of cases that occur in practice the external fluid pressure is so small compared with the internal that it may be neglected.

That is $\frac{R}{r} = \sqrt{\left(\frac{f + q^{\circ}}{f - q^{\circ}}\right)}$,

and who further says: "If the internal pressure q° is equal to or greater than the sum, $f + 2\,q^{1}$, of the coefficient of strength, and twice the external pressure, no thickness, however great, will enable the cylinder to resist the pressure."

The factor of safety to be employed is a matter for the judgment of the designer, according to the use the cylinder is to be put to. I have a case in mind where a number of cylinders were required to work telescopically, while under hydraulic pressure. It was important that the weight should be kept down. A factor of safety was adopted sufficient to prevent the cylinders bursting, but it was found on trial that the enlargement of the cylinders was so great as to prevent them working, and they had to be made thicker to resist this enlargement.

I. MCKIM CHASE.



HAND-OPERATED BRIDGE CRANE.

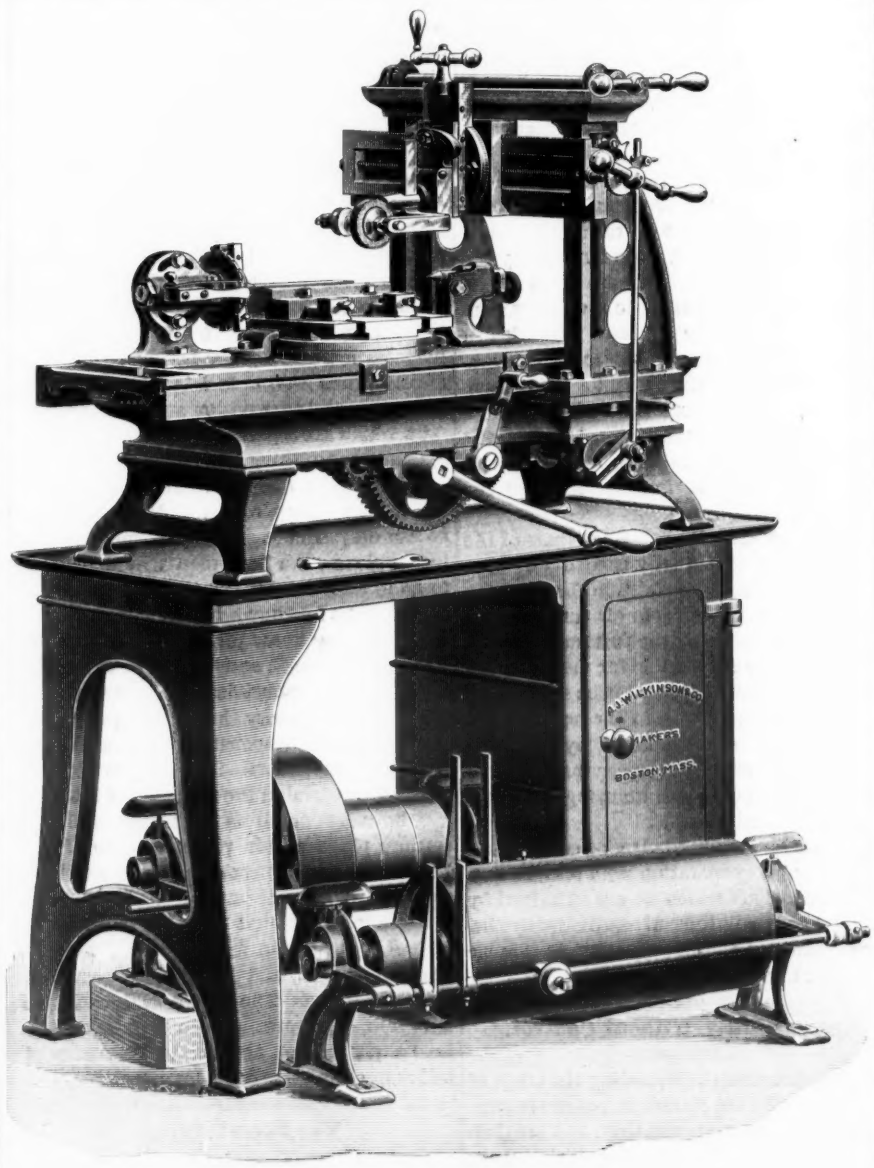
Hand-operated Bridge Crane.

We present with this an engraving of a crane, which is designed for such service as that required over a machine shop floor on which the smaller tools are located; where erecting of moderate weight machinery is done, or in the foundry.

The crane consists essentially of two steel I-beams, placed side by side, proportioned to the span and load with ample strength, so that there is no undue deflection with the maximum load at the center. At each end are the truck wheels, which are supported as shown, both these and the trolley wheels having roller bearings. One wheel at each end of the bridge is driven by the gearing shown, the shaft extending from one end to the other, so that the movement is uniform.

The trolley runs upon a track which is placed on top of the bridge beams, thus securing the maximum headway or room under the crane for lifting—a feature of some importance where ceilings are low.

The hoist provided is the well known Teal machine, in which steel spur gears are used exclusively, these being usually made with two hoisting speeds. The load is self sustained at any point, lowering being accomplished by pulling back on the hoist chain. The chain wheel for moving the bridge can be placed at any point in the length of the shaft. The builders are the Maris Machine Co., Philadelphia, Pa.



POWER OR HAND PLANER.

Power or Hand Planer.

We illustrate with this a small planer which is designed to be driven either by hand or power, being intended especially for model makers, experimenters, gunsmiths, amateurs, etc. It is so designed and built as to be capable of doing the best and finest quality of work, having all the improved features usually found upon planers of high grade. The change from hand to power driving is made by simply sliding a pinion, and when worked by hand there are no gears in use that are superfluous or unnecessary.

As shown, the planer is mounted upon a substantial table, at one end of which there is a cabinet for keeping tools and fixtures, and there is furnished with it a first-class chuck, improved indexing centers, and a grinding attachment by which true hardened surfaces can be produced.

The grinding attachment is shown in place in the tool-post, the spindle of this being driven from the drum shown on the floor, which is placed overhead near the countershaft. Elevating, and, in fact, all screws are of steel, accurately cut, all gears being also cut from the solid. It is built by A. J. Wilkinson & Co., Boston, Mass.

Recent experiments by Messrs. W. Thomson and F. Lewis on the action of metals on india rubber show that that of copper is the most deleterious. Platinum, paladium, aluminum, and lead act only very slightly; whilst magnesium, zinc, cadmium, cobalt, nickel, iron, chromium, tin, arsenic, antimony, bismuth, silver and gold have no action whatever on this material. Of metallic salts those of copper are very destructive; but nitrate of silver, manganese oxide and several less common salts are equally so. The nitrates of iron, sodium, uranium and ammonia have also a deleterious action, though less pronounced than in the case of the salts previously mentioned.—*English Mechanic.*

"The Plattdeutschenvogelschuetzengesellschaft contemplate taking a trip in the near future over the line of the Electrictischesstrasseeisenbahnwagengesellschaft."—*Kenton Herald.*

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
96 FULTON ST., NEW YORK.

PUBLISHED WEEKLY AT
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
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FRED J. MILLER, }

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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$4.00 a year to Other Countries, postage prepaid.

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"Business Specials," 50c. a line.

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Publishers' Agents, New York.
DEALERS SUPPLIED BY
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The American News Company, New York, N. Y.
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Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne,

NEW YORK, APRIL 7, 1892.

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Change of Location.

On May 1st, the AMERICAN MACHINIST offices will be moved about two blocks west from their present location to the new *Mail and Express* building, which fronts on Broadway, at No. 203, and on Fulton street, numbers 164–8. We shall then have increased room and better conveniences and facilities for carrying on our work.

Authority of Officers of Corporations.

A glance at a recently published volume treating of the law of corporations in New York State reveals some facts that are not, we believe, generally understood by those who are interested in, or do business with, corporations or their agents, the statements being based upon both statute law and decisions of the courts. As the same principles probably apply to other States, some little notice of the matter may be useful to many of our readers.

Stated in general terms, the officers of a corporation have no authority outside of that given them by the by-laws of the corporation, and they have no general authority whatever simply by reason of their titles alone. A president as such has no authority to bind the company; he cannot borrow money for it, nor can he authorize the treasurer to do so. Where there is, on the books of a corporation, a resolution prohibiting the president from purchasing goods required in the business of the company, the company is not liable for such purchases made by him. In the matter of a company note it is not sufficient to prove the signatures of the president and treasurer; there must be proof that there was authority for such signing of the note, this authority being derived from the by-laws. Persons dealing with officers or agents of corporations are bound to know their powers and the extent of their authority, for the company will not be held liable for acts of its officers outside this authority.

All this, of course, is in the interest of the stockholders and the trustees, but it would seem to the lay mind to be rather one-sided; for, as matter of fact, it is practically impossible for persons dealing with corporations to take the trouble to investigate and keep posted upon the precise authority of the different officers of the many corporations with whom they may be doing business, and it would manifestly be impracticable when receiving an order signed by the president or secretary of a corporation to write for the latest revised transcript of the by-laws before filling it.

It is thus seen that a large part of the business that is actually carried on must rest upon a basis of faith in the integrity and honor of the officers of corporations, modified, however, by the further fact that acorporation is responsible for unauthorized acts of its officers, provided it be shown that these officers have been in the habit of performing such acts sustained by the company, or where the company has received the benefit of the act, or, knowing of it, does not promptly disavow it.

It is to be presumed also, of course, that an officer of a corporation who performs an unauthorized act which is not sustained by the company, will himself, individually, become liable for the act, the same as if done solely for himself.

Responsibility Without Control.

Our recent remarks regarding the trials of mechanics who are placed in positions supposed to involve responsibility, and are then not allowed sufficient control to enable them to do themselves justice, have, it seems, touched a responsive chord in the breasts of many of our readers, who have taken the trouble to gratify us by writing letters approving our views on the question, and warmly commending our expression of them. The fact is that there are very many mechanics—more than most people who do not enjoy exceptional opportunities for observing would believe—that are in positions where they know that it is utterly impossible for them to do as well for their employer as they ought to do, simply because either they are absolutely prevented from doing what their experience and judgment tells them should be done, or, to persuade the powers that be to consent to some change or improvement requires so much scheming, so much persuasion or so much downright driving, that there is little energy or time left for the performance of legitimate and proper work. We know of very many employers who are simply defrauding themselves by refusing to allow good men in their employ to make use of the experience and ability possessed by them, and which they are anxious to place at the employers' disposal.

In our former remarks on this head we instanced the cases of two employers who were not practical men, and one of our correspondents, who happens to be foreman in a shop controlled by men who are not practical, seems to have an idea that such men are the only sinners in this respect. But this is by no means so; for some of the worst cases we have ever known of interference with and hampering of foremen and superintendents have been in shops owned and controlled by men who prided themselves on being practical and on "knowing and keeping track of every detail of their business." It is true that practical men are not so apt to fall into this error, because generally they are better able to appreciate the position of a foreman or superintendent, and to understand that there is no use of their having brains unless they are to be allowed to use them. Then, too, the interference of a proprietor who is a practical man is apt to be far less irritating, because it will usually be intelligent interference, and there will be less necessity for long explanations of things which the unprofessional proprietor can never hope to understand, no matter how much they may be explained to him. Still, after all these exceptions and allowances are made, the fact remains that there are shops owned and controlled by practical men, in which there is no real demand for men as foremen or superintendents who have any administrative ability whatever, and where precious little mechanical ability will answer too; and this for the reason simply that the employer can never be brought to believe that others can atttend to the details of his business just as well or better than he can himself, thus leaving him free to give attention to general supervision and the larger affairs which are a part of every business that amounts to anything.

When a man finds himself in a position where he is hampered, and plainly sees that he can do justice neither to himself nor to his employer, the best plan will usually be to go to him, frankly state the case, and ask that lines be laid down for all concerned, so that each may know just exactly how far his authority extends, and to what extent he will be held responsible for results, remembering that authority should always be commensurate with responsibility. If such lines will not be laid down—if the proprietor insists upon retaining the privilege of interfering in every detail as he sees fit and upsetting plans at his pleasure, then if the foreman or superintendent has any ambition to develop himself into a really valuable man, or to retain what value he may possess, he had better begin looking out for a new position at once, and leave his present one for another man who is not bothered with ambition and cares for nothing except to hold a position at any required sacrifice of self-respect and—to draw his salary.

The Patent Office.

The crowded condition of the U. S. Patent Office, to which we have before referred, has at last resulted, it seems, in the practical breaking down of one department of the work of the office, since it is announced that no more copies of current patents can be sent out to applicants for them until better facilities are provided for storing them. In the meantime we suppose there are thousands of books of blank orders which have been sold to citizens all over the country, with the understanding that, by simply filling out the blanks and mailing them, copies of patents specified would be sent.

If a private firm should thus neglect to carry out its plain obligations there would probably be some remedy, and that remedy would be very quickly applied. But in this case there is probably no remedy, and things will be no better until a sufficient number of congressmen have been impressed with the necessity of doing something about it. It is often of great importance to manufacturers, inventors and designers to obtain promptly copies of patents as issued, so far as they apply to certain lines, and, in view of the fact that the government is regularly making a very handsome profit out of the patent office, it would seem to be nothing less than an outrage that those from whom this profit is made should be deprived of the means of knowing what is being done by other inventors, because another department of the government (land office) has been allowed to encroach upon the patent office until there is actually not enough room in which to do the business. It would be a good idea, perhaps, if every inventor or manufacturer who finds himself inconvenienced by this matter would immediately write to his congressman, urging upon him the necessity for taking some action in this matter. When enough of such letters are received by members of Congress to make an impression upon them, something will be done about it. This practice of writing to congressmen, regarding any abuse which seems to need remedying, is one which should be more generally followed. It is altogether probable that if say twenty-five to fifty prominent manufacturing firms and inventors should write to the congressmen representing their districts, complaining of this thing and asking that something be done about it, something would be done.

Literary Notes.

WAYS AND MEANS. For Machinists, Metal Workers, Model Makers, Watch and Tool Makers, Jewelers, Draftsmen, etc.

This is an eminently practical book, written by a mechanic whose experience has evidently been mostly on watch and watch tool work, and in it he gives a great many valuable points of information regarding the best or accepted methods of doing such tool work as is done in watch factories and other places where similar results are desired. The book contains 125 illustrations, with descriptive matter telling how to go about doing the things which the ordinary machinist unused to such work is always wondering and inquiring about, many of the methods and principles illustrated being adaptable to other lines of work. The book will not make a rough or poor mechanic a good and fine one, but will enable a good mechanic, unused to the class of work referred to, to adopt correct methods and choose proper materials and tools. The information given is very much condensed, as much so as is consistent with clearness, so that in the 158 4½"x7" pages a great deal of valuable information will be found. John W. Weston, publisher, 78 La Salle street, Chicago, Ill. Cloth, $1.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(138) A. M., West Hoboken, N. J., writes: Kindly let me know through your paper how to prepare cup leather for air pumps. I have tried different ways of preparing them, but have not found any which does not lose air. I have tried soaking in lard and glycerine, but they are not right. *A.*—Soak the leather in water for about 24 hours, and use the right kind of dies. Your trouble is probably caused by using dies of an incorrect form.

(139) O. S., Richmond, Va., writes: Please inform me through your journal what method is adopted for galvanizing cast-iron and cast-steel. *A.*—The castings should first be thoroughly cleaned; to do so, prepare a bath of one part muriatic acid and two parts of water; immerse the castings and allow them to remain in it a few hours, then wash them thoroughly in hot water. Dip them in a solution of sal ammoniac and water, ½ pound to the gallon, hot. Dry quickly and dip them in the zinc bath.

(140) H. A. S., New York, writes: Kindly answer the following: I have a compound engine in my boat, 5 and 10-inch cylinders, by 7 inches stroke, making 300 revolutions per minute, with a boiler pressure of 250 pounds per square inch. What should be the size of air pump? *A.*—Single-acting air pump, 3½ inches, 5 inches stroke. 2. Will a foot valve be required? *A.*—Yes. 3. Would you advise a combined air and circulating pump, or independent ones? *A.*—If a combined air and circulating pump for so small an engine can be bought, we should use it.

(141) T. W. R., Prince's Bay, N. Y., writes: Kindly inform me through your columns, of which mechanical power or elementary parts the toggle or toggle joint is composed. Also, please give me a rule for computing the power to be exerted, the weight to be overcome, the length of arms or links, and the velocity ratio. *A.*—The toggle or elbow joint is simply composed of an assemblage of levers. For computations relating to it, see our issues of February 20 and 27, and for the practical application of the same, see our issue of March 27, 1890.

(142) D. W. F., Bradford, Pa., writes: Please send me a catalogue of books on mechanics. I wish to procure a book on drawing and millwright work. I should prefer something plain and easily understood, as I desire to make it a study during leisure hours, and I will have to be my own instructor. *A.*—We do not sell books of any kind, and, therefore, we do not keep catalogues for distribution. Write to any dealer in scientific works. In our issue of February 19, 1891, we have indicated a course of study to be pursued at home, with a list of books which we believe will be suitable for the purpose. The articles on Practical Drawing, recently published in the AMERICAN MACHINIST, should enable you to get a good knowledge of drawing.

(143) A. H., ——, writes: It is required to make a triple-expansion engine with high and intermediate-pressure piston on one rod, and the low-pressure cylinder on another, making only two rods and two cranks at 180 degrees for the three pistons. Can you give me some simple rule in arithmetic to proportion the areas of the pistons so that the high and intermediate pistons combined shall do about the same amount of work as the low-pressure cylinder? *A.*—We cannot give any simpler rules than are given in the papers treating on compound and triple expansion engines, by J. Tribe, published in our columns; the first of these papers appeared in our issue of August 20, 1891. To design an engine of the type you mention requires a knowledge of the principles involved, and these you will find explained in the papers referred to.

(144) P. G. S., Philadelphia, Pa., writes: In preparing paper for blue printing, is it not as well to coat paper with a soft camel's-hair brush, so as to float the liquid; will it make any difference? *A.*—We have used a brush, and a sponge; we prefer the latter for ordinary office use, because the sponge will retain more liquid than the usual size of brush used in an office, and consequently the paper can be prepared quicker, which is of importance when the room is not very dark. For preparing very great quantities, a large camel's-hair brush will probably be the best to use. In our experience we found no difference in the result with either the use of brush or sponge. 2. Is it better to keep the liquid in a bottle than to prepare the paper if it is not to be used for a few days? *A.*—If the paper is properly prepared it can be kept in good condition in a dark place for several weeks; it is not necessary to prepare it just before it is to be used.

(145) J. W. S., St. Paul, Minn., writes: Kindly inform me through your paper how to remedy our boiler furnace. The dimensions are as follows: Length of boiler, 10 feet; diameter, 24 inches; length of flues, 9 feet; 18 in number, 2¼ inches in diameter. Grate surface, 30 inches by 26 inches. The boiler is bricked up, and is externally fired. The height of chimney is 65 feet, with two flues 8 inches by 8 inches at the bottom, where the stack from the boiler enters. We have removed the wall between the two flues, in order to get a draught. I put a 6-inch pipe at the back end of the boiler, so as to reduce the quantity of gas passing through the flues, and run the pipe to the chimney. There is considerable waste of fuel, but I cannot get draught any other way. We carry 60 pounds pressure, and use about 8 horse-power. Can you suggest any remedy? *A.*—The description of your plant is rather vague. If we understand you correctly, there was not a sufficient draught before the change, and now you have too much. If this is the case, put a damper in the chimney.

(146) S. T. W., Baltimore, Md., writes: I see an answer to my question in this week's issue. I fear you have misunderstood my question. I wanted information about a kind of iron called gun metal. I was down east a short while ago, and saw some crank-shafts in certain engine works that were made of gun metal; I would therefore like to know something about that metal. *A.*—The iron used for ordnance purposes is simply a certain mixture of different kinds of cast-iron, carefully selected, to give it strength and shock-resisting power, and yet allow it to have such ease of working as shall make its manufacture reasonably inexpensive. An examination of the analyses of good ordnance iron shows it to contain

Carbon combined	1.70	per cent.
Carbon graphitic	2.20	"
Silicon	0.30	"
Phosphorus	0.44	"
Manganese	3.55	"
Magnesium	0.06	"
Aluminum	0.28	"
Calcium	trace.	
Iron	91.84	per cent.

Its specific gravity was 7.22, and tenacity, 31,734 pounds per square inch.

(147) C. H. W., Newark, O., writes: Please inform me through your columns what process is necessary to produce a bright, glossy black japan finish that will not rub off on small pieces of cast-iron. *A.*—A durable and lustrous black coating for metals can be obtained as follows: Procure a cylindrical iron pot, say about 18 inches in height, cover its bottom with powdered bituminous coal half an inch deep; above this put in a grate and fill the pot with the articles to be coated. Articles of cast-iron, wire, brass, zinc, steel, tinned iron, etc., may be subjected to the same treatment. The cover is then put on and the pot heated over a coke fire under a well-drawing chimney. In the beginning the moisture only evaporates, but soon the coking commences and deep brown vapors escape, which irritate the throat. When the bottom of the pot has been heated for 15 minutes to a full red heat, the coal has been mostly converted into coke; the pot is then removed from the fire, and after standing 10 minutes opened, for evaporation, all the articles will be found covered with the above described coating. This lacquer is not only a protection against oxidation of metals, but will also stand a considerable heat, only disappearing at beginning of redness. The coating produced is thin, lustrous, and cannot be easily scratched. Articles made of tin, or sol dered, cannot be subjected to this process, as they would fuse. Smaller articles, like hooks and eyes, receive this coating by heating them together with small pieces of bituminous coal in a cylindrical sheet iron drum like that used for roasting coffee, until they present the desired lustrous black appearance.

(148) W. E. M., Chester, S. C., writes: A few days since a customer called and stated that he was having trouble on account of the flues in his boiler leaking, and asked that a man be sent to examine them. I sent a man, who soon returned and said that a flue was bursted, and that a new one would have to go in. Accordingly the old flue was taken out and a new one put in. Now when I came to examine the old flue I found it perfectly sound in every respect, except a number of small round holes on the top side of the flue. This led to a further examination, which showed that all the flues were in the same condition. The boiler is an ordinary return tubular boiler 48 inches in diameter, 10 feet long, with forty-eight 3 inch tubes. I have sent you a short piece cut from one of the old flues. You will notice that it is perfectly sound in every way excepting the small round holes, which look as if they had been cut by some small insect. The boiler is a good one, made by a party in N. Y. State, and has only been in use about 18 months. As I have never seen or read of anything like this, will you please explain through your columns how these holes come to be in the flues? *A.*—This is a clear case of pitting, and we believe it is due to the intense local action of fatty acids, or other particles of corrosive substances. It is difficult to locate the cause of the trouble without seeing the boiler and its surroundings, but we believe that the pitting is caused by the water used. Although rain water is the purest of all natural waters, it may hold in suspension injurious substances which have been gathered on the roof and carried by the water into the cistern. We should advise you to have the water analyzed at once, which may enable you to trace the cause and devise some preventive. Your case is similar to the one stated in Question 408, in our issue of October 16, 1890.

(149) C. M., Wausau, Wis., writes: Recently on inspection of a battery of boilers, the mud drum was found to be badly pitted, and the inspector advised the discontinuance of the mud drum, and suggested that the boilers be fed separately. He explained that the water was so free from impurities that it had formed no protecting scale, and that it had free action on the boiler and mud drum. Now this is a new theory to me, as in my nearly twenty years' practice and experience with boilers I have always believed that the purer the water and the freer from scale the boiler and attachments may be, the better for them and the owners of the plant. Please give your opinion. *A.*—You are right to some extent in saying that the purer the water the better for the plant and its owner; but frequently some kinds of the purest waters contain substances which will form on the plates small patches of scale of irregular shape, varying from ½ inch to 1 inch in diameter, causing corrosion or pitting underneath the scale, sometimes to a considerable depth. This we believe to be the cause of your trouble, and removing the drum will not remove the cause, although in your case the drum is evidently unnecessary. We should advise you to have the water analyzed, which may enable you to remove the cause; otherwise, even if you remove the drum, the same injurious action will take place on other parts of the boiler. Probably you are using rain water collected from the roof; this often causes pitting; if so, you may avoid the injurious action by taking the water from some other source. A scale thicker than that of an egg shell is of course injurious, but a thin scale not thicker than that of an egg-shell, or even in some cases $\frac{1}{16}$ of an inch thick, will be advantageous, as it forms a coating protecting the boiler from the corrosive action of the water. This is by no means a new theory; in fact, some engineers contend that absolutely pure water should not be used in boilers, and lay the cause of pitting to its use.

(150) A. C., Houghton, Wash., writes: Please give me a formula employed in determining the weight that is necessary to balance the moving parts, such as piston, piston rod and connecting rod, when the counterbalance must be placed in the pinch wheel. The crank of our engine possesses so little material that to drill it sufficiently to lash the balance in the usual manner would weaken it and invite risk. Hence in the pinch wheel, which is forward of the engine and very close to the main journal, seems to be the most advantageous place to remedy the defect. Perhaps I should have stated before, that the engine is a 10x10-inch vertical marine engine, with main bearings 3½ inches diameter, crank-pins 3x3½ inches. Our present pinch wheel only balances the crank. We wish to put in a larger pinch wheel, and are told the larger the wheel employed the smoother the engine will run, and also less weight will be required for the counterbalance. Now we have not determined the weight of the moving parts nor the diameter of the wheel that could be employed, but if possible from the foregoing please give an example to illustrate the formula by assuming some weight for the moving parts and a diameter of the wheel. The engine is of the single non-condensing type. *A.*—The pieces to be counterbalanced are the crank, crank-pin, crosshead, connecting rod, piston and piston rod, but how much of their weights should be balanced is a matter of debate among engineers. Probably counterbalancing 75 per cent. of the total weight will give good results. The weight of the crank must be referred to the crank-pin. To do so, we must know its center of gravity. If the crank is of uniform width and thickness throughout, and symmetrical in form, then for all practical purposes we may consider the center of gravity to coincide with the center of crank, and in this case it will be 2½ inches from the center of the shaft. Now multiply the distance from the center of gravity of the crank to the center of shaft (2½ inches) by the weight of the crank, and divide this product by the length of crank; that is, from center of shaft to center of crank-pin (5 inches); the quotient will be the weight referred to the crank-pin. If the weight of crank is 50 pounds, then $\frac{50 \times 2.5}{5} = 25$ pounds, which is to be referred to the crank-pin. To this add the weight of pin, crosshead, connecting rod, piston rod and piston; 75 per cent. of the sum of these weights is that which must be counterbalanced, and this multiplied by the length of crank must be equal to the product obtained in multiplying the distance from the center of shaft to the center of gravity of the counterbalance. If the total weight which is to be counterbalanced is 240 pounds, and the center of gravity of the counterbalance is 12 inches from the center of shaft, then $\frac{240 \times 5}{12} = 100$ pounds for the weight of counterbalance. The center of gravity of the latter is usually found by making a small pattern of it, and balancing it on a knife edge. From the foregoing it will be seen that, in increasing the diameter of the wheel, the counterbalance will be moved further from the shaft, and consequently less weight will be required. A large pinch wheel will, of course, be heavier than a smaller one, and since its action is similar to that of a fly-wheel, the large one will tend to produce a steadier motion of the engine. The counterbalance should not be placed in the pinch wheel if it can possibly be avoided.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Note the cat on page 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N. Y.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

A. D. Pentz, Consulting. Tools, Elizabeth, N. J.

See Gage advertisement below.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Gage Tool Co.'s Self Setting Plane does more and better work in less time. On trial. Vineland, N. J.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill

For Foundrymen's Metallic Pattern Letters and Figures, send to Knight & Son, Seneca Falls, N. Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

S. A Smith, 23 S. Canal St., Chicago, Ill., is agent for Holbrook's new loaded rawhide mallets.

"Boiler Tests by Barrus." Get sample pages from Gowing & Co., Mason Building, Boston, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus air pumps, acid blowers, filter press pumps, etc.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

For Sale—Patent for screw cutting gauges, illustrated in this week's issue. Address Sam'l Jeffs, 213 W. Seventeenth St., Erie, Pa.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide S. A. Smith, 23 S. Canal Street, Chicago, Ill, western agent.

25″, 32″, 37″, 42″ — "Only Drill Press built on 'Ko-rekt' principles, Even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Complete treatise on Screws and Screw-making with clear and concise explanation of the methods; 95 illustrations. Price, $1.25 postpaid. E. & F. N Spon, 12 Cortlandt St., N. Y.

What do you want to buy? We will send without cost to you, catalogues, price lists, and information concerning anything you wish. Paret, Willey & Co., 265 Broadway, N. Y.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases.
31 Nassau street, New York.
Send for Brief History of Patent Legislation.

We will pay 15 cents each for copies of the AMERICAN MACHINIST of December 25, 1886 issue; must be unsoiled, and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY 96 Fulton Street, New York

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

A Novel Locomotive Boiler.

An English correspondent writes:

A new eight-wheel passenger engine has been recently set to work on the Northwestern Railway of England, the novelty in which lies in the boiler. From the fire box there are the usual tubes, but they are only very short and communicate with a combustion chamber, from which the usual set of long tubes passes to the smoke box. By what mode of thought the designer of this boiler was led to place a combustion chamber after a set of small tubes will perhaps puzzle all engineers who have had experience in coal combustion.

If there were any combustion to go on after the furnace products leave the fire box, it would certainly never take place after the quenching action of a few hundred small tubes.

Probably the combustion in this engine will be practically perfect, and there will be no smoke, but it certainly will not be be-

cause of this new-fangled combustion chamber, but because with a fire-brick arch and deflector plate, as usual in English practice, the combustion will be perfected in the furnace.

It is astonishing that at this late date such a contrivance should have been dreamt of by any boiler designer. How can combustion be again possible in boilers after the passage of gas through tubes? The idea is ridiculous, and a poor excuse for adding several feet to the length of a boiler, and an extra pair of holding-up wheels.

If the upper portion of the fire box had been continued forward without the set of short tubes there would have been sound sense anyhow in the idea.

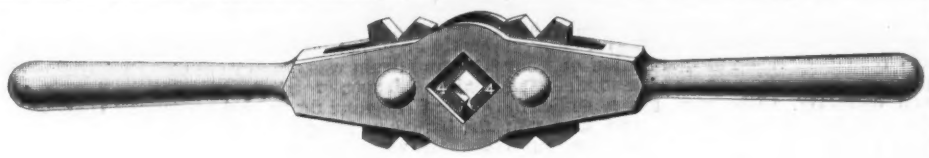
The blacksmith occupied an important position among the craftsmen of the middle ages. The insecurity of life and property, which was one of the chief grievances of the times, made strength of material indispensable, whether to guard the shrine of a saint or to protect after a more homely fashion the family chest or coffer. The strength and durability of iron led to its use for these defensive purposes from early times. But the workman of the middle ages was not content to allow strength and ugliness of form to go together, but contrived to breathe a spirit of beauty into his designs without sacrificing the use to which the material was destined Thus wrought-iron formed the object of much artistic work both in England and abroad. Until coal came into general use malleable iron was produced direct from the ore with charcoal fuel by continuous working. Sussex was from early times a chief seat of the iron industry. The earliest positive record of the trade there is contained in a grant made by King Henry III. to the town of Lewes in 1266, by which the inhabitants were empowered to raise toll for the repair of the town walls after the battle. Every cartload of iron destined for sale which came from the neigboring "weald" was to pay 1 penny toll, and every horseload of iron half that sum. In 1290 a sum of money was paid to a certain Master Henry, of Lewes, for the iron work to the monument of Henry III., in Westminster Abbey, which reminds us that talented smiths were brought often from long distances for important works —*Chambers' Journal.*

Remarkable if True.

It is reported that the fly-wheel of a wood-sawing machine recently burst out in Minnesota, one of the pieces striking a boy, eight years old, mangling him horribly and instantly killing him. This looks reasonable enough; but when we are informed that the piece that killed the boy, carrying him sixty feet, was found one and one-half miles from the scene of the disaster, the story looks a little strong.

A boiler on a German coast defense vessel recently exploded, severely injuring several men. The vessel is only three years old, and the boiler had been in use not more than half that time. As usual, the cause of the explosion is not known. An investigation had been ordered. If this investigation is of the order of those generally made in the instance of the explosion of boilers on shore, it is safe to predict that the cause will remain unknown.

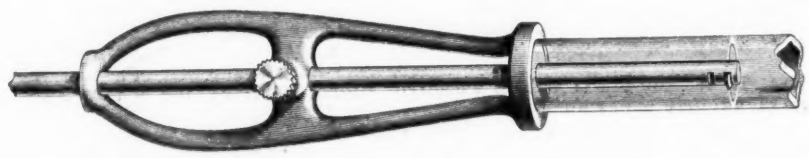
The exterior of buildings is now cleaned by the sand blast. The front is covered with staging, and the blast is applied by a system of pipes and nozzles carried by the workmen. The stream of fine sand issuing from a nozzle removes a layer of 1.64 inch thick from the surface of the stone, and a square foot of surface can be cleaned in ten minutes. The sand can be employed over again. —*London Tid-Bits.*



A New Tap Wrench.

We present with this an illustration of a new tap wrench, which, instead of being adjusted to different sized taps by means of a sliding jaw and screw, is provided with two disks having at their edges rectangular notches, which, when brought together as shown, form a square opening into which the tap or other squared tool fits. It is only necessary to bring correspondingly numbered notches together, and friction washers placed at the side of each disk prevent them from moving out of position accidentally, or when it is necessary to remove the wrench from the tap.

The wrench is very well and substantially made, with tempered steel disks. Three sizes are made, 10", 14" and 18" long, by F. W. Randall, Danbury, Conn.



Simple Glass-tube Cutter.

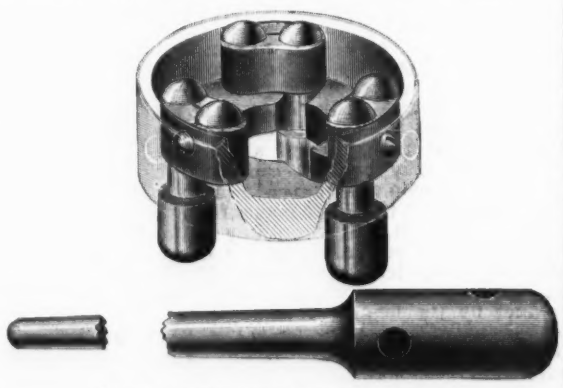
We illustrate herewith a glass-tube cutter in which the requirements of such a tool seem to be reduced to their simplest elements.

The handle consists of a brass casting adapted to receive the steel wire or rod, near the end of which is mounted the small steel roller which does the cutting. The wire is adjustable in the handle to cut at any required distance from the end of the tube, and it is only necessary to introduce the wire, lay the tube on some solid support, and roll it along until the cutter has made a complete circuit. The tube is then easily broken off square and smooth, either in the hands or by a light blow upon the corner of the bench. A tool which we have tested does its work perfectly. It is made by Pancoast & Maule, Philadelphia, Pa.

"Giles" Adjustable Tube Expander.

We illustrate herewith a new tube expander, in which a taper pin is used for expanding the rollers, these rollers being tapered just half as much as the pin, so that when in place the outer surfaces of them are parallel to the tube.

The rolls are so put in that they are very easily changed, being put into a split bearing which swings on a piece riveted to the head. To change rolls it is only necessary to take out a machine screw, change the rolls and re-insert the screw.



Giles Adjustable Tube Expander.

By this means one tool is made to cover a wide range of sizes, the smaller one being suitable for tubes of any size from 2" to 3" inclusive, the larger one for tubes 3" to 4" inclusive. This makes it especially adapted for smaller shops or for a jobbing tool in larger ones, or in establishments where there are steam plants to be kept in order, and the range of sizes of tubes is large.

The body of the tool is made of steel, turned and milled to the form shown, and the rolls are of tempered steel. Five sets of rolls are furnished with each tool. The makers are the Oswego Tool Co., Oswego, N. Y.

Screw Cutting Device for Lathes.

The accompanying illustrations give two views of a device for indicating to the lathesman at any time when the nut can be closed upon the lead screw of the lathe so as to "catch threads" properly. Fig. 1 shows the device as in use upon a lathe, while Fig. 2 gives an enlarged end view, detached.

The device consists of a light plate from which a semi-circular arm projects, which is fitted to slide freely on top of lead screw, and another and smaller casting with a semi-circular arm is made to move vertically in a slot in lower part of the plate, the circular part of small casting to be babbitted to conform to thread of lead screw. To the upper part of the plate a pointer is attached, and on the lathe carriage a scale, preferably graduated in inches, is secured. In operation the nut in carriage is thrown in as usual, and the device is moved along the lead screw until the pointer it carries is opposite the graduation most distant from carriage. The lower arm carrying the internal thread is then brought into contact with the lead screw, which is accomplished by turning the small handle to its highest position. When the lathe is started the carriage scale and pointer move at the same rate. At the end of the cut the nut in carriage is released and the carriage run back as usual; the pointer is still traveling toward the carriage, and when it arrives opposite a graduation the nut of the carriage is then thrown in, thus insuring the tool entering the work correctly. Should the pointer approach close to carriage before the thread to be cut is completed, it can be moved back again to the graduation farthest from the carriage while the tool is cutting, as the nuts always enter easily whenever the pointer is opposite any graduation. Should circumstances require its use on the other end of carriage, it is as effective there as on the end shown in engraving. As the device is supported entirely by the lead screw, it is easily adapted to any lathe by simply babbitting the lower half nut. The device has been recently patented by Sam'l Jeffs, Erie, Pa.

Fig. 2.

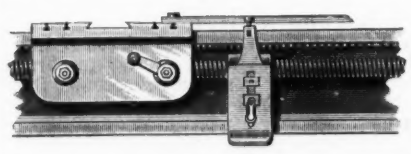


Fig. 1.

Screw Cutting Device.

The growth of the beet sugar industry is shown by the following statistics: In 1887 there was only one beet sugar refinery in this country. This produced 400,000 pounds of sugar. In 1888 the total output was 3,600,000 pounds, while in 1891 California produced 13,000,000 pounds and Nebraska and Utah 6,000,000 pounds each.

Manufactures.

Spoor Bros. will erect a machine shop at Lacon, Fla.

Guy R Pride will start an ice factory at Jacksonville, Fla.

Hugh Hannan will erect a brick machine shop at Springfield, Mass.

The establishment of an electric light plant is talked of at Maiden, N. C.

The Stupp Brothers Bridge and Iron Company is enlarging its plant at St. Louis, Mo.

The Millen (Ga.) Ice and Electric Co. has been organized, with a capital stock of $8,000.

At Fort Smith, Ark., the St. Louis & San Francisco Railway Co. will erect machine shops.

J. H. Miner will engage in the manufacture of patent saw-mill dogs, etc., at Biloxi, Miss.

Three new furnaces will be added to the Wellman Steel Works, at Thurlow, Pa., this summer.

The Merrimac Valley Railroad Company is building a 45x25 foot power-house at Lowell, Mass.

Another paper-mill will probably be erected at Kalamazoo, Mich, by a $100,000 stock concern.

The Lawrence Manufacturing Co. has been incorporated in Columbus, O.; capital stock, $30,000.

The Asheville (N. C.) Street Railway Co. will erect an electric power plant at a cost of $100,000.

It is stated that the Warwick Iron Company, of Pottstown, Pa., will make application for a new charter.

There is a report that the Albion (N. C.) mills will add dyeing machinery and 1,200 spindles to their capacity.

Joseph Dixon Crucible Co., Jersey City, N. J., intend to build a saw-mill at their mines at Ticonderoga, N. Y.

At Corry, Penn., the Ajax Iron Works have been incorporated, with capital of $60 000, to manufacture machinery.

Fay & Scott, of Dexter, Maine, are building an addition to their machine shop, which is to be of brick, 50x90 feet.

Work is to begin soon, it is reported, on the new cotton-mill at Newport News, Va. W. A. Post can give information.

A number of enterprising citizens of Americus, Ga., are quietly at work pushing a movement to build a cotton factory there

The Trimont Mfg. Company, of Boston, will locate their wrench factory at Oswego, N. Y., an inducement having been offered.

The Fort Payne (Ala.) Rolling mill Company voted at their recent meeting to sell their entire property to a new organization.

The Union Foundry and Machine Works, Frederick, Md., is to add an additional molding room to its foundry and machine shops.

The city of Cuthbert, Ga, will probably erect an electric light plant and construct water-works. The mayor can give information.

A charter has been issued to the Rowley & Hermance Company, iron and steel manufacturers at Williamsport, Pa. The capital is $325,000.

It is stated that Philadelphia parties are in correspondence with G. R. Crane, of Tullaboma, Tenn., relative to establishing a cotton-mill there.

The new plant of the Anderson Rolling-mill Co., of Anderson, Ind., at Muncie, Ind., will be in operation in about a month, giving employment to 300 men.

The Hogeland Cushion Car Wheel Co, of Chicago, has been organized, with a capital of $25,000, by Israel Hogeland, D. W. Wood, and M. H. Rylott.

Church & Sleight, of 109 Fulton street, N. Y., have taken the agency for the Sebastian Lathe Company, of Cincinnati, and will keep their lathes in stock.

Baltimore parties will organize a $500,000 stock company, to establish a plant at Sparrow's Point, Md., for the manufacture of stoves, ranges, furnaces, etc.

The remodeling operations at the tin-plate factory of the U. S. Iron and Steel Co., Pittsburgh, Pa., are about completed, and work will soon be running in full.

The Washington Construction Co., of Seattle, Wash., has been organized by George Atkinson, Jr., B. Pelly, C. T. Tyler, and E. B. Downing. The capital stock is $250,000.

The Place M'f'g Co., Oswego, N. Y., has issued a price list of tube expanders, pipe tools, hand punches, and various other small tools. The various tools are illustrated.

Work is to be begun soon on the new cotton-mill, Jonesville, S. C., as subscriptions amounting to $50,000 have been received. C. D. Farrar, of Union, is pushing the enterprise.

The Egan Company, Cincinnati, Ohio, are putting in a new steam plant; engine and boilers 250 H. P. The company will erect additional buildings, which will add 25,000 square feet to the floor space.

The Manufacturing Construction Co., of Knoxville, Tenn., is being formed, for the purpose of engaging in the building of bridges and other structural work. The capital stock is to be $250,000.

There is water-works agitation in Lake City, Minn.; New Richmond, Wis; Kansas City, Mo.; Glendale, Ohio; Amarilla, Texas; Denton, Texas; Ithaca, Michigan; Cohoes, N. Y; Rouse's Point, N. Y.

A bill has been introduced in and passed the Virginia legislature, authorizing Warren County to borrow $12,000 for the construction of a bridge over one or each branch of the Shenandoah River at Riverton.

The Richmond (Va) Railway and Electric Co. is reported as having purchased Johnson's Island for $30,000, and as to erect a $125,000 plant on same for the manufacture of electricity for arc lights.

Sing Sing, N. Y., will soon lose two of its industries. The Arcade File Works are about to remove to Atchison, Kan. They employ 250 men. The Monitor Iron Works are also desirous of locating elsewhere.

The Schenectady Locomotive Works, of Schenectady, N. Y., have awarded John McDermott, of that city, the contract for the building of their new foundry. The building will be 346 feet long and 100 feet wide.

Wesley Drane has purchased the interest of E. C. Bates in the iron foundry of Whitfield, Bates & Co., Clarksville, Tenn. The foundry will be greatly improved and enlarged, and will be operated under the name of Whitfield, Drane & Co.

The Charleston Construction Co., of Charleston, S. C., has been formed by J. S. Murdoch, J. F. Ficken, A. T. Smythe and others, with capital of $50,000. The company proposes to deal in all kinds of machinery and mechanical devices.

The Carolina furnace of the North Carolina Steel and Iron Company, at Greensboro, N. C., will be completed by about June 15th. The officers of the company are as follows: J. A. Odell, president; C. D. Benbow, secretary and treasurer; J. D. Case, general manager.

The Sterling Steel Co., near McKeesport, Pa., is expending $65,000 on additional shops. There will be a hammer shop, machine shop, and a warehouse, all to be finished by April 15. In the new shops steel projectiles will be made for the United States Government.

The Philadelphia Drop Forge Co., American and York streets, Philadelphia, Pa., manufacturers of drop forgings in iron, steel, copper and aluminum, issue an illustrated catalogue of a large variety of forms and shapes made at the works.

In connection with its foundry at South Lawrence, Mass., the Emerson Mfg. Company will build a machine shop 275x50 feet, with an L 100 feet long for wood work. The enlargement, which is made necessary by increasing business, will increase the capacity of the company 50 per cent.

The additional machinery recently placed by the Springfield Iron Co., of Springfield Ill., has greatly increased the capacity for the production of track bolts. The company will shortly be in a position to increase its output 50 per cent. more than was possible before improvements were made.

W. D. Troutner, Pittsfield, Ill., finds himself obliged, through an increase in his work, to build new and larger shops: machine shop foundry and blacksmith shop, also engine room. He does general repairs of engines and boilers, saw-mill and other machinery, furnishes brass castings, etc., etc.

The Congdon Brake Shoe Company, of Chicago, is erecting an iron building 200x110 feet, which will contain a 12 ton open hearth steel furnace and a 24-pot crucible steel furnace. It is expected that the plant will be in full operation by June 1, making general steel castings and material for the Ross-Meehan shoes.

The Ansonia Brass and Copper Co., 19 to 21 Cliff street, N. Y., have enlarged the catalogue relating to Tobin bronze. This little catalogue gives a good deal of information in regard to this metal, its strength and uses. It also contains a large number of testimonials from those who have used it for various purposes.

The Stow Flexible Shaft Co., 26 Callowhill and Biddle streets, Philadelphia, Pa., has issued a new catalogue of flexible shafts, and a large number of machines and tools that can be profitably used in connection with the shaft for a variety of purposes. Engineers, mechanics and manufacturers will find matter of interest in this circular.

The Trask Milling Machine Co., 118 South street, Boston, Mass., have adopted a new plan for making milling machine cutters. The cutters are formed by a milling process, and in gangs instead of separately. It is claimed that this gives perfect shape, and that any standard cutter can be duplicated without the slightest variation.

The new machine shop for the Henry R. Worthington Hydraulic Works, at South Brooklyn, N. Y., will be built of iron by the Berlin Iron Bridge Co., of East Berlin Conn. The building will be 200 feet long by 50 feet wide, with a 20 ton Sellers traveling crane. The building is made from the designs of the Berlin Company, who furnish it complete, including the foundations and brick-work.

Machinists' Supplies and Iron.

NEW YORK, April 2, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $16.50 to $17.50; No. 2, $15.25 to $16.50; Grey Forge, $14 to $14.50. Southern brands of good quality are obtainable at $15.75 to $17 for No. 1 Foundry; $15 to $16 for No. 2; and $13.50 to $14 for Grey Forge.

Scotch Pig—Coltness is quoted at $21; and $20.25 for Eglington.

Antimony—The market is steady and quiet.

We quote Hallett's, 10⅞c. to 11c.; Cookson's, 14½c. to 15c; and L. X., 13c. to 13½c.

Copper—The market has a downward tendency. Lake Copper has declined to 11.95c. Casting Copper is quoted at 11.50c. to 11.75c.

Lead—The situation is dull, but slightly firmer. Holders are asking 4.25c., and buyers seem disposed to pay 4.20c. The movement is reported light.

Lard Oil—The market is firm at 56c. to 57c. for Prime City. Western on spot is quoted at 55c. to 56c.

Spelter—The market is firmer. A few car loads have been sold at 4.52½c. for New York delivery. Quotations are nominal at 4.55c. to 4.60c.

Tin—The market is easier and the demand is quiet; 19.90c. to 19.95c. is quoted for spot.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Draftsman, graduate of institute, 7 years' experience, desires change. 86 Friend St., Boston, Mass.

Wanted—Position by mechanical draftsman; references. Address B. C., AMERICAN MACHINIST.

Exper'd mechanical draftsman desires a position in New York or vicinity. BOX 87, AM. MACHINIST.

A young carriage-smith of 20 will work a month for an opportunity to learn the machinist's trade in a good shop. Address Reader, AM. MACHINIST.

Wanted—Boiler maker wants position as foreman; long exp. in all kinds of boiler and general iron work. Address D. A., AMERICAN MACHINIST.

Wanted—Position by a first-class mech. eng., with thorough technical and practical education, excellent drafts'n & mach't. A. B., care AM. MACHINIST.

Wanted—Position as foreman of tool room or superintendent of machine works; 10 years experience and best references. Superintendent, AM. MACH.

Wanted—First-class man of ten or twelve years' experience as assistant foreman in job shop. Address BOX 86, AMERICAN MACHINIST

Wanted—Position as chief draftsman or assistant superintendent. Tech. graduate; 12 years' exp. on gen. mach'y in above positions. Box 83, AM. MACH.

Wanted—First-class foreman pattern maker for shop of eight to ten men. Must be able to "get there," and not by the longest road. Address Box 81, care AMERICAN MACHINIST.

Draftsman and good vise hand wishes to make a change; has experience in designing stationary and hoisting engines; can handle men. Address BOX 88, AMERICAN MACHINIST.

Engineer, practically, technically, thoroughly educated; experienced in machine tools, steel wks., conveying mach'y, well known, good address, desires selling position in N. Y. Honesty, AM. MACH.

Wanted—A No. 1 pattern maker, familiar with mining machinery and general engine work; must work himself and have charge of two or three other men; we want both mechanical and executive ability; location West. Box 85, AM. MACHINIST.

Engineer Wanted—A cotton-mill in the South, running on the 10-hour system, is looking for an engineer, to commence work about May 1st; engines are double, tandem, compound condensing, 20x36x48; wages, $3.00 per day; engineer to do his own repairs. Address Box 84, AMERICAN MACHINIST.

Wanted—Position as draftsman in Mass. or R. I.; eight years draftsman on general mill work, interchangeable work, special tools and jigs; also five years machinist; can take charge of men; technical graduate. Address "System," AM. MACHINIST.

The successful superintendent of an unsuccessful concern thinks it is about time to make a change; is skilled in the manufacture of small interchangeable work in the best and cheapest manner, and knows how to run a business; will not go away from New York. Business, AMER. MACHINIST.

Wanted—Position as supt. or foreman, by a young man, successful in the systematic manufacture of machinery and mechanical devices, and in the economical management of men; a designer and draftsman of automatic and interchangeable machinery, tools, jigs, etc. W. S. H., AMERICAN MACHINIST.

Wanted—An educated mechanic, who is thor'ly up in modern practice; must be a first-class draftsman and designer, and competent to take charge of drafting-room and handle work in shop, by a Co. building a special line of mach. tools. State salary expected, exp., and refs. A. B. C., AM. MACHINIST.

Wanted—A thoroughly competent and reliable middle aged foreman for machine tool works; must be experienced in machine tool building, in managing men, and well up in modern machine shop practice. Give references, particulars, and salary expected. Correspondence confidential. Address The Henley Machine Tool Works, Richmond, Ind.

Wanted—Position as draftsman or in charge by a draftsman and pattern maker. Well up in general shop practice. Accustomed to handling men. Familiar with job and duplicate work, jigs and templates, smith and foundry work. First-class references; will go anywhere. Address Tangent, Fulton Foundry, Virginia, Nev.

A mechanical engineer, technical graduate, in good position now, speaking Spanish and French fluently, well experienced in Cuban sugar plantation mach'y, desires change with parties doing business with Cuba or other country, direct or indirect. Can act as correspondent, translator, salesman, sup't'd erection, and draftsman. X. Y. Z., AM. MACH.

Wanted—A young man for foreman or superintendent of machine department, who has had practical experience in our line, and is up in modern shop practices of producing interchangeable work in quantities, accurately and at low cost. A. L. Ide & Son, builders of high-speed engines, Springfield, Ill.

A prac. and educated mech. eng., who has successfully filled positions of charge and responsibility in mfg. concerns, is open for engagement; good executive; well up in modern mach. shop practice and labor-saving devices; also in economical production of duplicate and interchangeable parts; exp'd in adapting old and originating new mach'y and methods to decrease cost of production; can take charge of the erection of a plant from ground up, including equipment. Progressive, AM. MACH.

✝ MISCELLANEOUS WANTS ✝

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Best Crank Shaper $225. Am. Tool Wks., Clev., O.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

PURE FEED-WATER For Steam Boilers.

THE BUNNELL FILTER AND PROCESS

Furnishes Steam Boilers with water that is absolutely freed from all scale producing substances. Guaranteed or no sale.

BRADLEY & COMPANY, SYRACUSE, N. Y.

HOW TO RUN ENGINES AND BOILERS.
Practical Instruction for Engineers and Steam Users.
By EGBERT POMEROY WATSON.
Editor and Proprietor of "THE ENGINEER," New York City.
$1.50 by Mail.
Author of "Modern Practice of American Machinists and Engineers," "Manual of the Hand Lathe," etc., etc.
150 Nassau Street, New York.

STEEL TUBES WELDLESS SMOOTH · COLD DRAWN John S. Leng's Son & Co. New York.

W. C. YOUNG & CO., Worcester, Mass. Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC

THE PRACTICAL CATECHISM.
(Questions and Answers on Engineering Subjects.)
By ROBERT GRIMSHAW, M. E.
18mo, Red Cloth, $1.25.
JOHN WILEY & SONS, NEW YORK.

POPULAR AND INSTRUCTIVE BOOKS
FOR ENGINEERS AND FIREMEN,
By STEPHEN ROPER, Engineer.
Embracing all branches of Steam Engineering. They are the only books of the kind ever published in this country, and are so plain that any engineer or fireman can easily understand them.
Descriptive Catalogue Mailed Free.
EDWARD MEEKS, Publisher,
No 1012 Walnut St., PHILADELPHIA, PA.

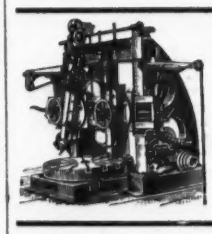
HILL, CLARKE & CO.

Boston, Mass., desire to announce that they have leased the store of

A. J. KIRKWOOD & CO.,
12 AND 14 SOUTH CANAL STREET, - - - - - - CHICAGO, ILL.

And will continue the business as the Chicago Branch of their firm, adding to the lines of Wood and Iron-Working Machinery hitherto carried, a specialty of High Grade

METAL WORKING MACHINE TOOLS



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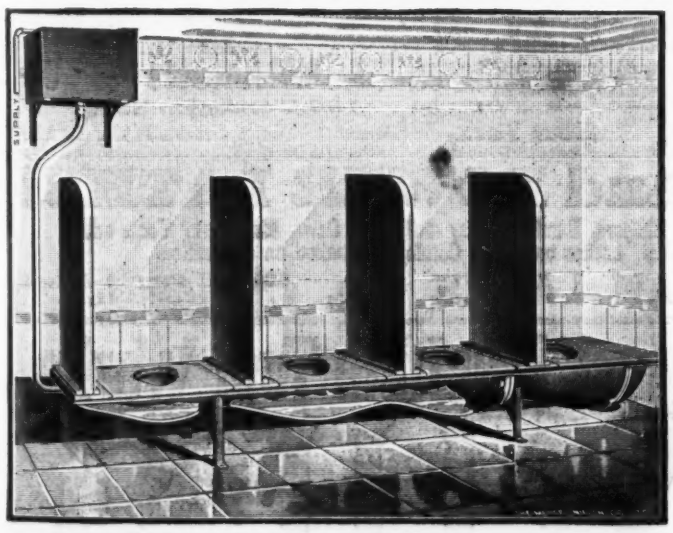
COMBINING EVERY IMPROVEMENT.
14 SIZES—FROM 5 TO 20 FEET.
BETTS MACHINE COMPANY,
WILMINGTON, DEL.

A PROPERLY CONDUCTED MANUFACTURING ESTABLISHMENT



Should provide its employees with decent Water Closet accommodations. This contemplates a simple apparatus easily kept clean and not liable to get out of order. These conditions are best met by the

EM-ESS PARSONS SCHOOL WATER CLOSET, successfully used in Schools, Factories, etc., for several years past. The arrangement of each basin in the section at a slightly lower level, with its weir or dam toward the outlet, is novel and important, securing an equal flush to each, with a minimum quantity of water—an important consideration when meter rates have to be paid. The flush is automatic at desired intervals.

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THE MEYER SNIFFEN CO., Ltd.
Manufacturers of
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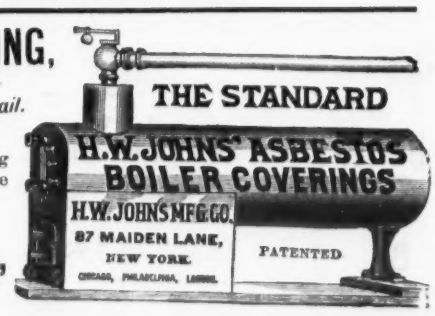
46 & 48 CLIFF STREET, NEW YORK.

ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.



Special machinery designed and built. C. F Langston & Co., 70 N. 4th St., Philadelphia.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Complete mach'y for mfg. horseshoes delivered by L. Ingermann, Minden, Westphalia, Germany.

For Sale—Patent for screw cutting gauges, illustrated in this week's issue. Address Sam'l Jeffs, 213 W. Seventeenth St., Erie, Pa.

Bound volumes for 1891. We are now prepared to take orders. Price, $4.00 per volume; express charges payable by purchaser. Address American Machinist, 96 Fulton street, New York.

Pat. KEY-SEAT SETTING GAUGE
PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND TWIST DRILL GAUGE
J. WYKE & CO Fine Machinists' Tools. E. BOSTON, MASS. Send for LISTS

Machine Tools in Stock.

ENGINE LATHES.

78 in. swing,	9 ft.	between centers			Sellers
38 do	17 ft.	bed.	New		Fifield
30 do	14	do	do		do
30 do	24	do	do		
27 do	16	do	do		
24 do	12	do	do		Fifield
24 do	12	do	do		Fitchburg
24 do	12	do	do		Flather
24 do	10	do	New Pattern		Fifield
22 do	12	do	do		do
22 do	12	do	New		Blaisdell
22 do	8	do	do		Flather
22 do	10	do	do		do
20 do	8	do	do		do
20 do	10	do	do		do
18 do	8	do	do		do
18 do	10	do	do		do
18 do	8	do	do		Blaisdell
18 do	16	do	do		do
16 do	6	do	do		Flather
16 do	6	do	do		Blaisdell
15 do	6	do	do		Flather
14 do	6	do	do		do
14 do	6	do	do		Blaisdell
12 do	6	do	do		do

PLANERS.

42 in. wide,	42 in.	high,	12 ft.	long, 2 heads	Gleason
36 do	36	do	8	do	Pease
30 do	30	do	8	do	do
30 do	30	do	8	do	Whitcomb
30 do	30	do	8	do	Flather
26 do	26	do	6	do	do
24 do	24	do	6	do	do
24 do	24	do	6	do	Whitcomb
22 do	22	do	5	do	do
22 do	22	do	6	do	Flather

SHAPERS.

12, 16, 20 and 24 inch stroke	Eberhardt
15 and 24 inch stroke	Hendey
32 inch stroke with key-seating attach.	Walcott

UPRIGHT DRILLS.

20, 21, 25, 28, 30 and 36 inch swing	Prentice
20, 23, 25, 28 and 34 inch swing	Blaisdell
60 inch swing Radial Drill	Baush

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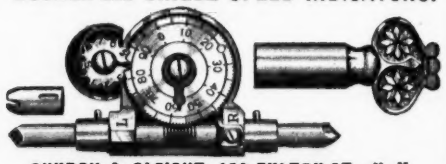
CHURCH'S
DOUBLE and SINGLE SPEED INDICATORS.



CHURCH & SLEIGHT, 109 FULTON ST., N. Y.

Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy Street, Providence, R. I.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent, Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

For Sale—Valuable Mfg. Plant in central Pa., consisting of Machine Shop, Foundry, Smith, Boiler, Patent Shops and Warehouses, with Patterns and Tools. Engine Patterns 5 H. P. to 350 H. P. Punch and Shear Patterns of the best machine now made. $20,000 worth of Patterns alone. Want to wind up the estate. $15,000 will buy the above. None should apply but those who mean business. Address Thomas J. McGuire, Towanda Pa.

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With modern plant and good connection, require the Sole License of a good Invention, which it will pay to advertise and push.

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MACHINE SHOP, FOUNDRY, BOILER, FORGE AND PATTERN SHOPS, with a full equipment of tools.

The works are located in the heart of the city, and convenient to railroad and river transportation.

For terms, apply to

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BRASS AND BRONZE CASTINGS
A SPECIALTY.

By a molder of 50 years experience. Castings guaranteed true to pattern. Get my prices.

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ALL KINDS IN STOCK.
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Chief Am. office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LD.

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We have removed our Machine Shop and Office to the corner of JOHN and DUTCH Streets, this city; where we have more room and much better facilities for handling our work. Office: 2 Dutch Street.

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Manufacturers of SENSITIVE BENCH DRILL PRESSES.
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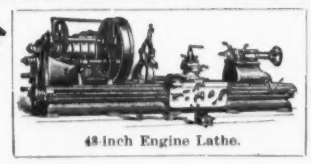
MANUFACTURERS OF THE CELEBRATED

FITCHBURG MODERN ENGINE LATHE

AND OTHER METAL-WORKING MACHINES



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Register Letters containing Money and Stamps.

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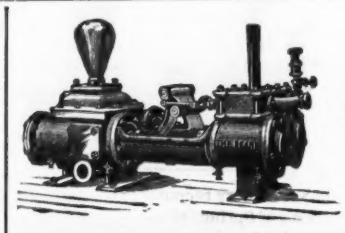

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SUCH AS JEWELERS' AND SILVERSMITH'S ROLLS, DIE BLOCKS AND MILLING CUTTER BLANKS.

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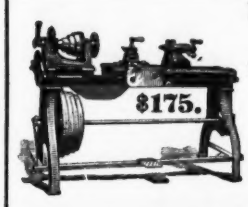

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THE TAPS PASS CLEAR, MAKING FULL
THROUGH THE NUTS, FINISHED THREADS
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DIES ALWAYS READY TRUE TO SIZE
PERFECT SCREWS AT A SINGLE CUT

FINE TAPS, DIES, REAMERS, ETC.
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Tap Wrenches, Bolt Cutters, Hand and Power Drilling Machines, Punching Presses and other Labor-saving Tools. SEND FOR NEW CATALOGUE.

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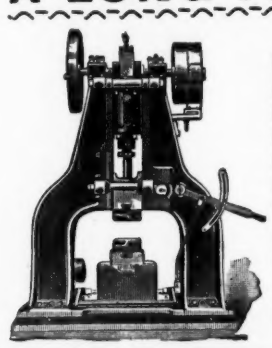
A LONG FELT WANT SUPPLIED.



A Power Hammer that is Controllable, Efficient and Durable.

TAKES THE MINIMUM OF POWER AND GIVES THE MAXIMUM OF EFFICIENCY.

The operator can control perfectly the force of the first or any succeeding blow and stop the hammer instantly.

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R. MUSHET'S SPECIAL and TITANIC STEELS.

How to get the best results with "R. MUSHET'S SPECIAL STEEL." Greatly increase your speeds and feeds; then compare the work you turn off with that done by any other known Steel. This will make the first cost of "Mushet's" look insignificant.

B. M. JONES & CO.,
Sole Representatives in the United States.
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143 Liberty St., NEW YORK.

FOR SALE.
NEW AND SECOND-HAND
METAL WORKING
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Send for list of same for immediate delivery.

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SECOND-HAND
METAL
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GEO. PLACE MACHINE CO.,
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STANDARD OIL CUPS.

FOR ENGINES & DYNAMOS.

HIGH SPEED MACHINERY.

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184 Washington Street,
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Drill Presses, Shapers, Band, Circular and Scroll Saws, Machinists' Tools and Supplies. Lathes on trial. Catalogues mailed on application.

SEBASTIAN LATHE CO. 43 & 45 Central Avenue, CINCINNATI, O.

Bridgeport Machine Tool Works
LATHES

E. P. BULLARD. PROPR. BRIDGEPORT. CONN.

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FILES AND RASPS
FOR EVERY VARIETY OF WORK.

THE BERLIN IRON BRIDGE CO.
Office and Works:
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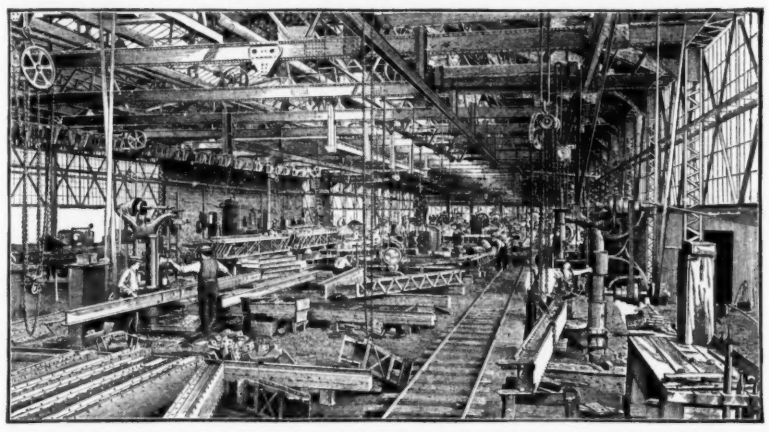
CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.



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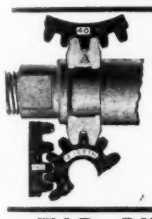

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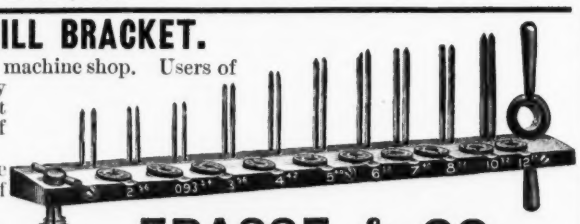

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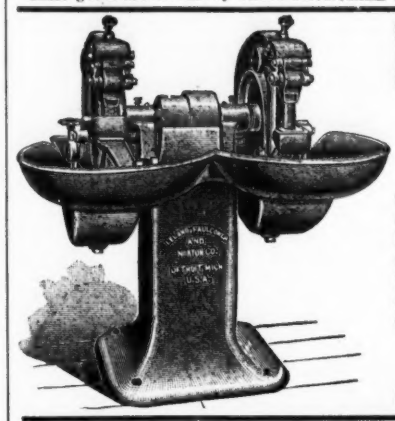

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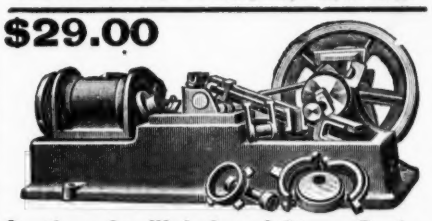

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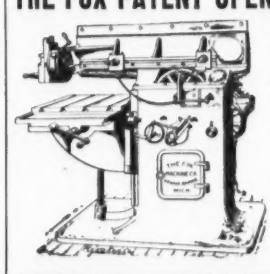

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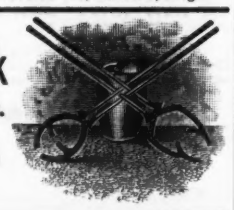

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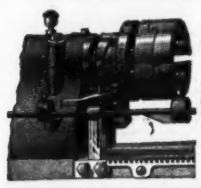

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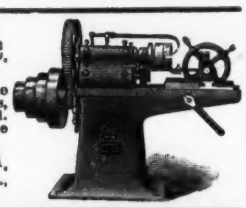

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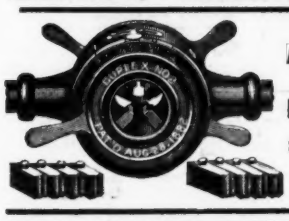

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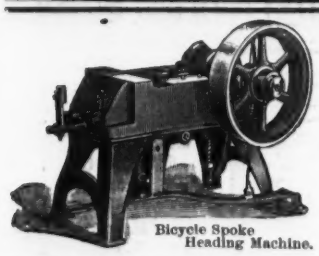

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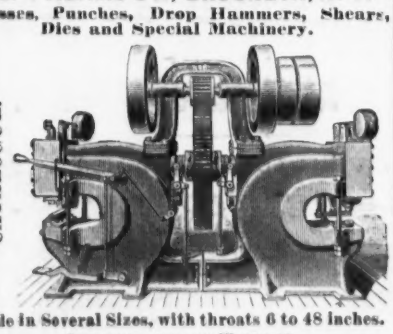

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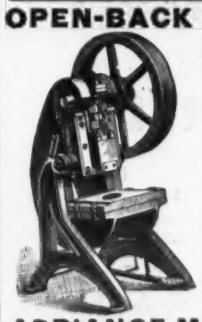

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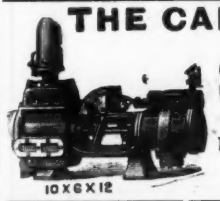

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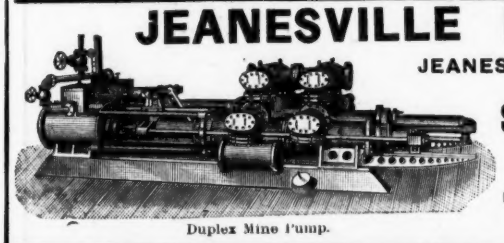

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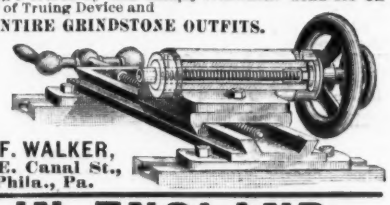

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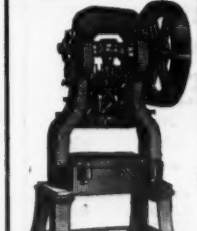

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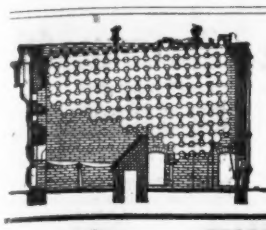

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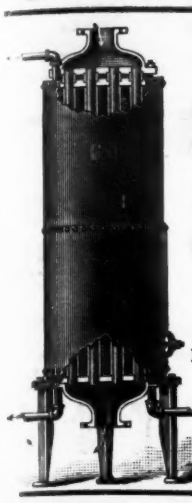

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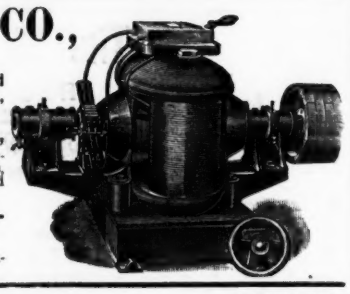

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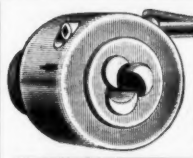

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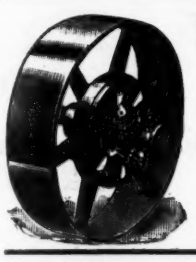

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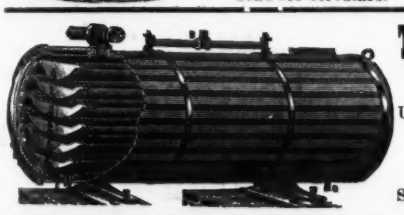

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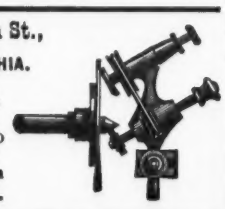

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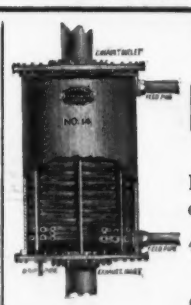

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24 in.	30 in.
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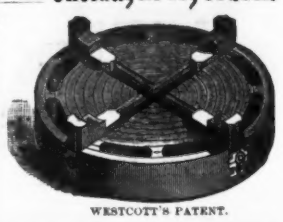

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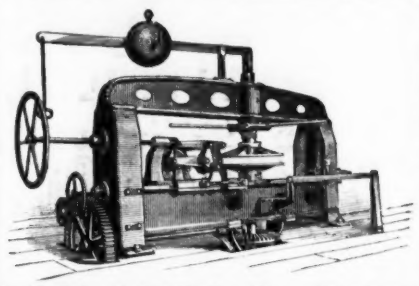

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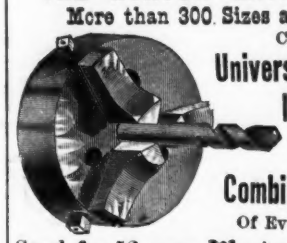

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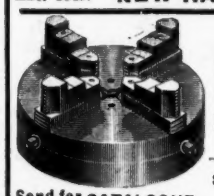

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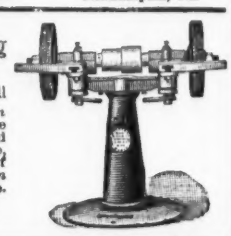

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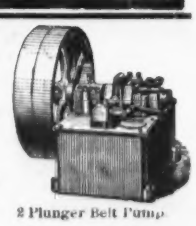

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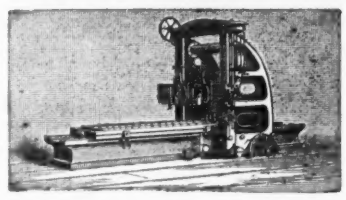

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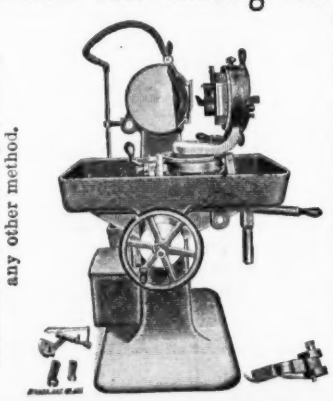

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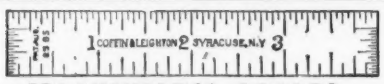

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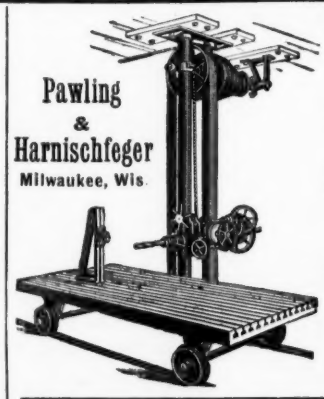

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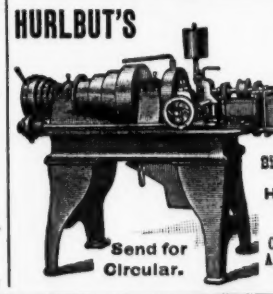

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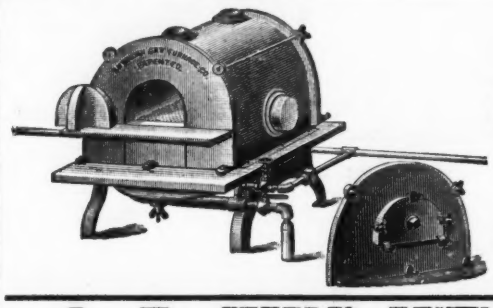

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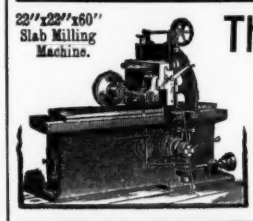

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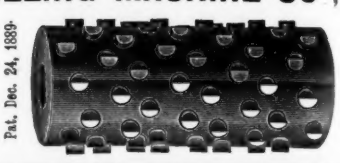

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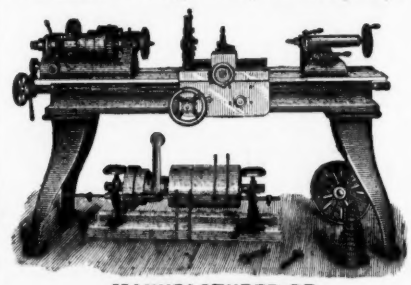

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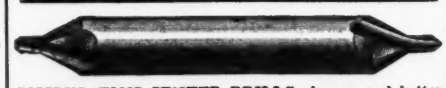

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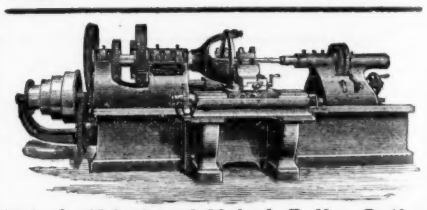

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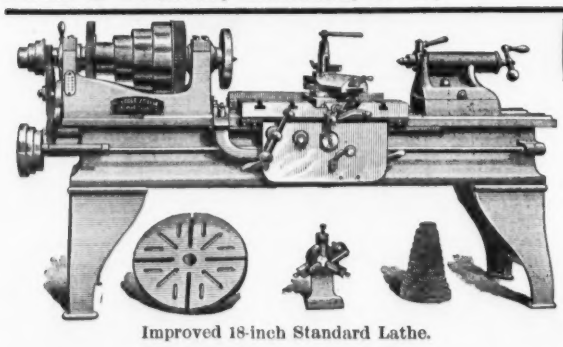

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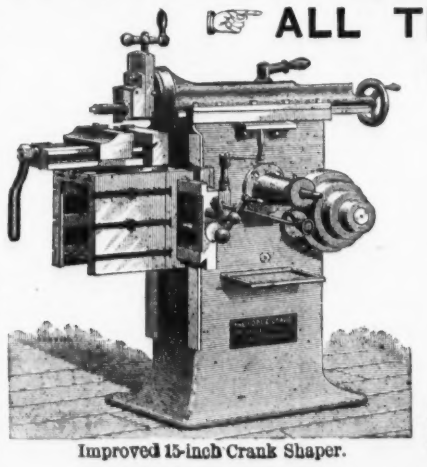

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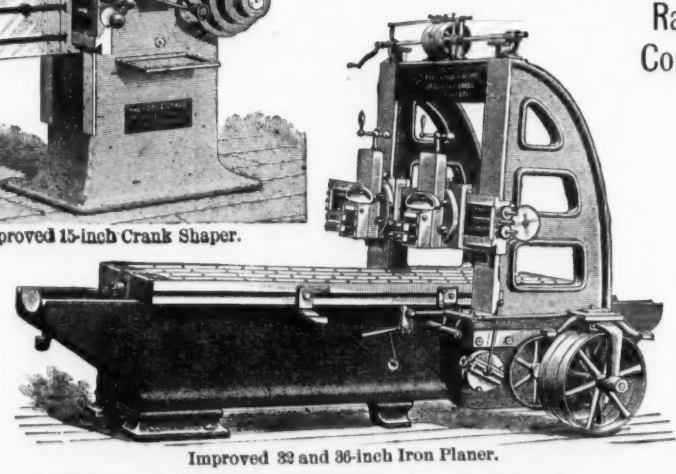

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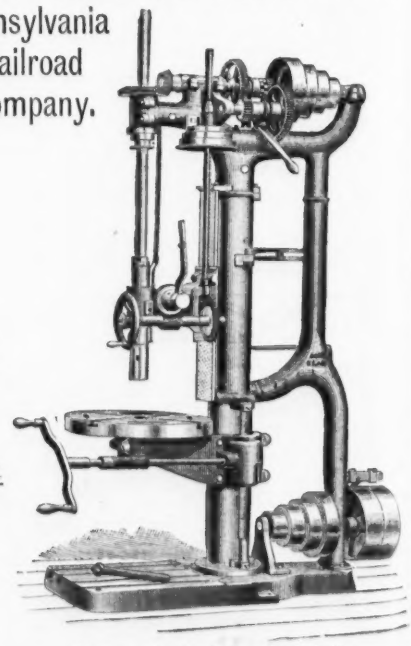

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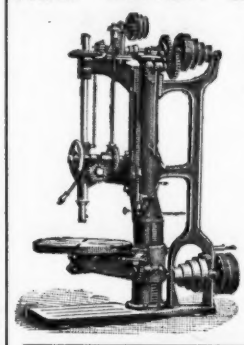

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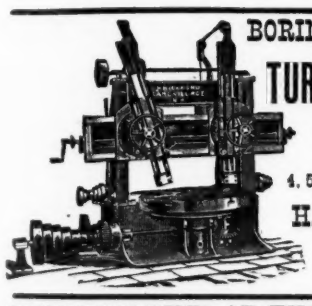

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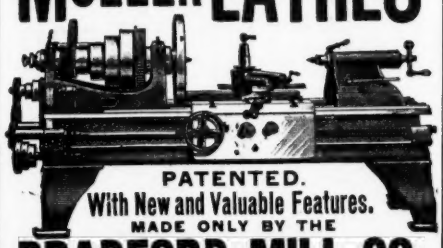

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Turret Drill Press.
SIX SPINDLE.
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Suitable for a large variety of work and is operated with ease and rapidity.
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Substantial, Well Made, Low Price, Patented,
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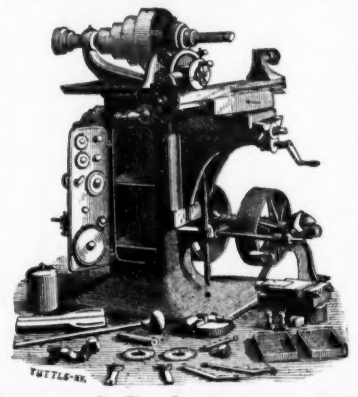

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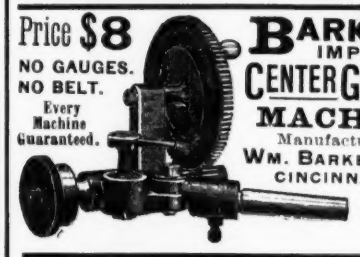

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Yours respectfully,
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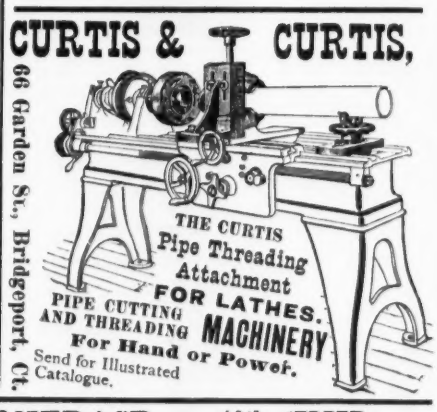

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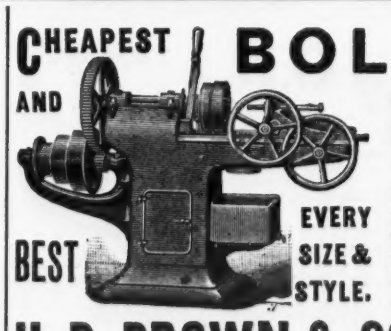

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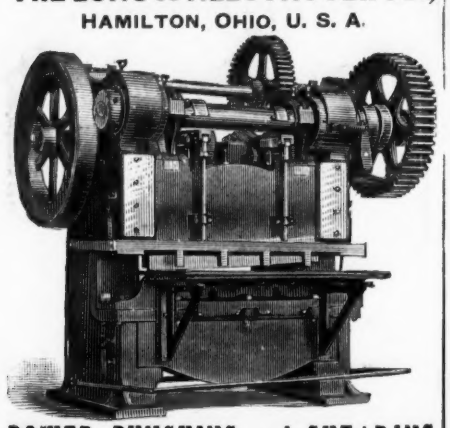

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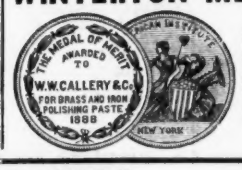

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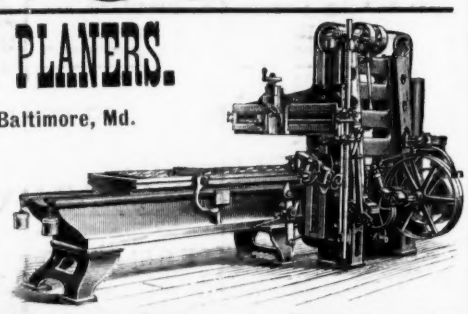

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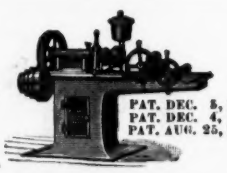

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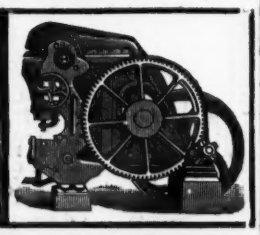

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You desire to be certain that your
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is always properly adjusted to the requirements of the Steam pressure.
THERE IS BUT
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PUT IN A
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It is a MARVEL OF ACCURACY, and is especially adapted to VERY HIGH PRESSURES; e. g., where compound steam engines are used for generating electricity, etc.
We GUARANTEE this DAMPER REGULATOR to operate on a variation well WITHIN ONE POUND in THE BOILER PRESSURE. MANY HUNDREDS have been put in operation during the past six years in the
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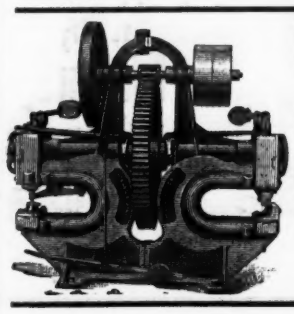

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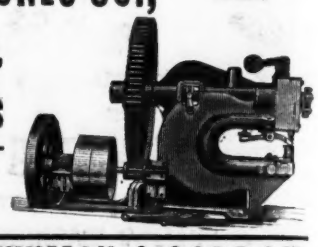

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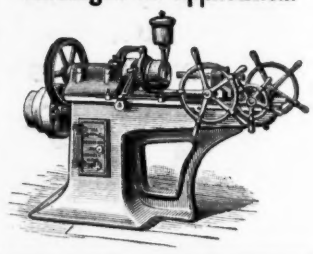

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You will make a mistake that will cost you money.

THE MORTON Lightning Key-Way Cutter is the only machine on the market that will cut a Key Way and make a Key to fit it. Mr. Geo. Newcomb, Salem, Mass., says as follows: "The Key-maker is a wonderful attachment, making keys faster than a man can cut off the steel for it. The Key Way Cutter does a piece of work in fifteen minutes which requires my man seven hours to accomplish by hand." We build machines with stroke varying from six inches to five feet, and cutting from the smallest Key-ways to six inches wide. MORTON MFG. CO., Muskegon, Mich.
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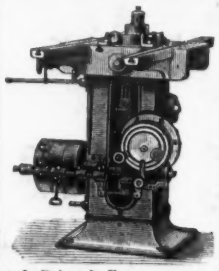
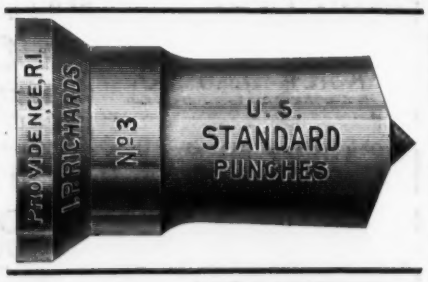
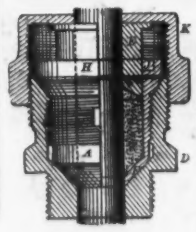


GIANT KEY SEATER.
Rack-Cutting Attachment
Key-Making Machines
VALLEY MACHINE CO.,
SAGINAW, MICH.
Cuyahoga Falls, O., Nov. 25, '91.
Gentlemen: The large KEY SEATER which we bought of you has now been in operation for a number of months, and we have been using it almost constantly since it was purchased, and we are very much pleased with it indeed. We also have a machine made by another firm, which we thought was a good machine, but now that we have both in our factory, and use them both, we like yours very much the best.
E. L. Babcock, Pres. The Falls Rivet & Machine Co.





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May be used in connection with either Hemp or Metallic Packing.
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MANUFACTURED BY
THE BURTON MACHINE CO.,
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It is the only machine we ever saw that works satisfactorily on long hub double arm pulleys, and is fast, economical, and does good work.
If it will be of any advantage to you we will be pleased to show the machine to anyone you may refer to us.
Yours truly, MEDART PATENT PULLEY CO.
SPECIAL MACHINERY BUILT TO ORDER.

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WRIGLEY'S EMERY WHEEL DRESSER
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Over 48,000 in Use.
Crescent Gauge. Flat Bar Gauge.
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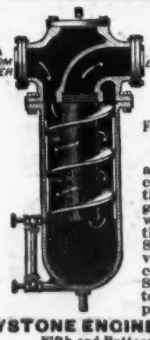
Simpson's Centrifugal Steam Separator.



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Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary
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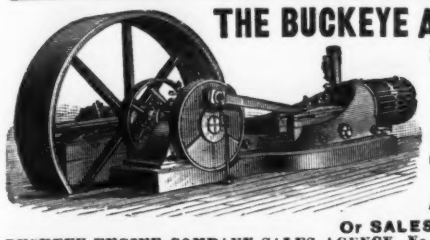

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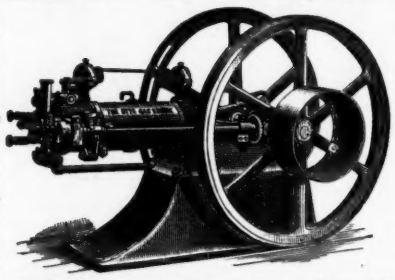

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With LIBERATING Valve Gear.

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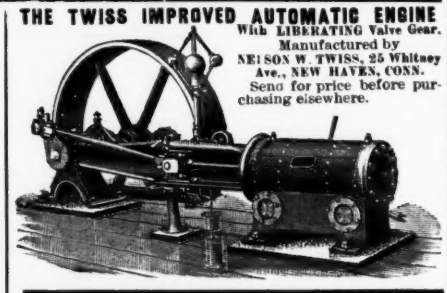

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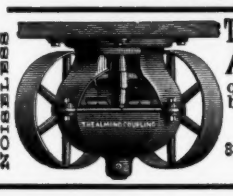

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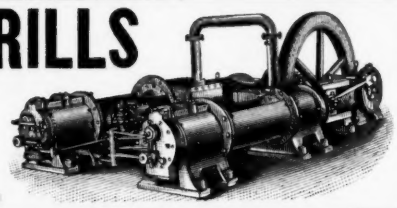

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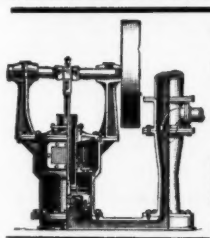

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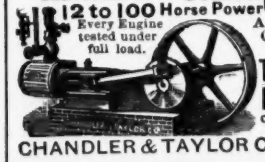

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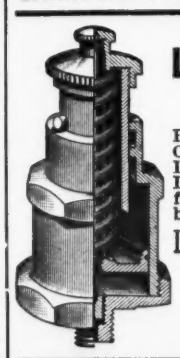

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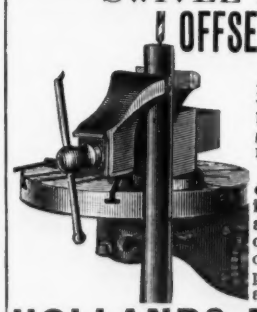

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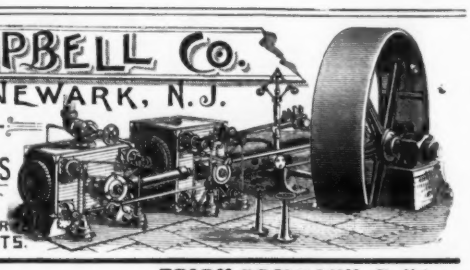

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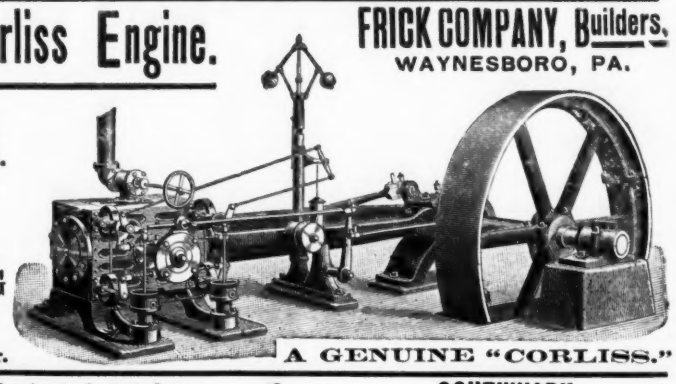

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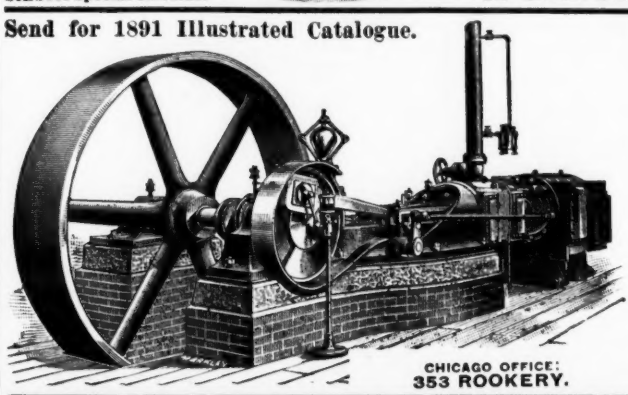

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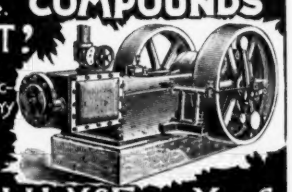

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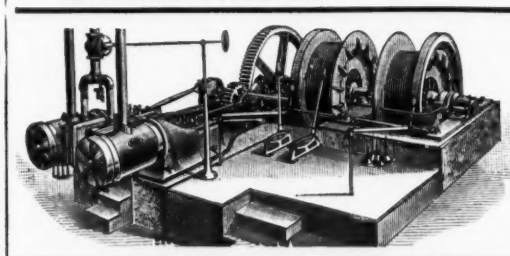

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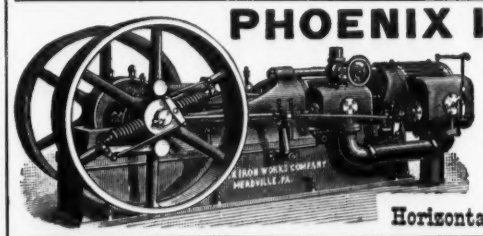

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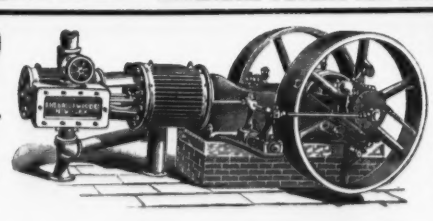

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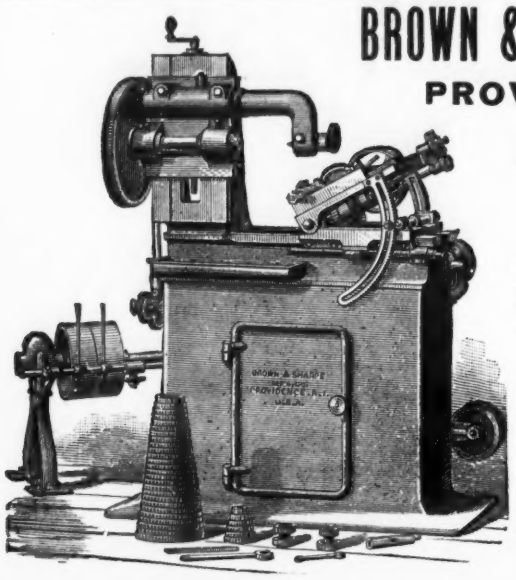

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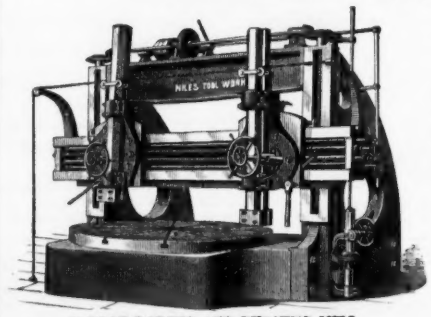

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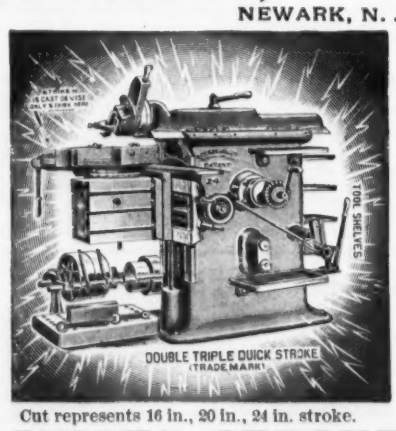

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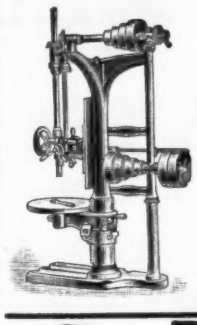

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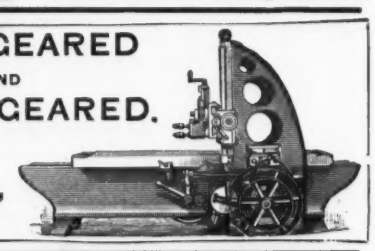

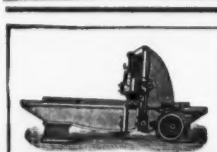

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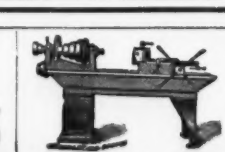

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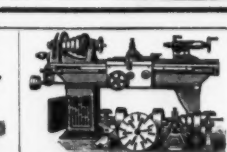

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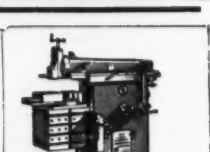

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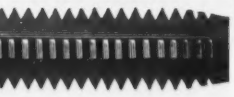

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